Monday, October 25
9:00am-10:30am

109 - Beyond the Factory Door: Environmental Issues After the Product Leaves the Factory

Leona Lewis
Corporate Counsel
Best Buy

Terry Thiele
Director, Sustainable Product Strategies
The Lubrizol Corporation

Faculty Biographies

Leona Lewis

Leona Lewis is Best Buy corporate counsel, providing legal support for the company's Environmental Affairs and Exclusive Brands teams among other business groups. Best Buy is a global retailer of technology and entertainment products and services, including its own Exclusive Brand consumer electronic products sold under the Insignia, Dynex and Rocketfish brands.

Prior to working at Best Buy, Ms. Lewis worked for business litigation firms specializing in business contract litigation in Minnesota.

Currently, Ms. Lewis serves on the Retail Industry Leaders Association Technical Action Committee for product safety.

Ms. Lewis received her BA from the University of Michigan and is a graduate of the University of Illinois College of Law.

Terry Thiele

Terry Thiele is the director, sustainable product strategies, for the Lubrizol Corporation, a specialty chemical company headquartered in Wickliffe, Ohio. He leads strategic business planning activities, with a heavy focus on regulatory monitoring and advocacy.

Prior to joining Lubrizol, Mr. Thiele was government relations counsel for AB Electrolux, North America, and the General Electric Company. Before that, he served as counsel in the US Treasury Department, Central Intelligence Agency, Defense Intelligence Agency, and the Executive Office of the President.

Mr. Thiele is a member of the Federalist Society and co-chairs the ACC Environment and Sustainability Committee.

He received a BA magna cum laude from Princeton University and his JD from New York University School of Law.

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Beyond the Factory Door:
Environmental Issues After the Product Leaves the Factory

Retail Perspective

Leona Lewis, Best Buy Corporate Counsel, Product Regulation and Environmental Law

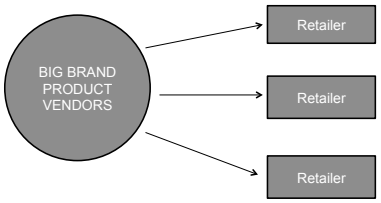
Best Buy

- Best Buy is a publically traded (NYSE: BBY) global retailer of technology and entertainment products and services.
- Best Buy has evolved from a single audio store to a large national brand.
- The Best Buy family of brands generates more than $49 billion in annual revenue across the United States, Canada, Mexico, the European Union, China & Turkey.

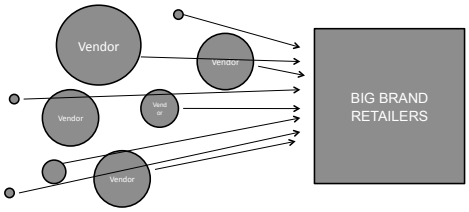
Televisions

In 2009 the average American home had 2.86 TV sets, roughly 18% higher than in 2000 (2.43 sets) and 43% higher than in 1990 (2.0 sets). Those 2.86 TV sets per home is more than the number of people in the average U.S. home, which is 2.5.

1990



2010



Perception of Responsibility Shifts to Retailers

- THEN (1996)
  - Kathy Lee Gifford & Nike sweatshop scandals
- NOW (2010)
  - Cadmium – over the past year Wal-Mart has been in the news over cadmium in children's jewelry

Shareholders Holding Companies Accountable

- Mattel
- BP
- Toyota

Gatekeeper of Consumer Goods

- Manufacturers are not typically found within the state
- Retailers have locations in the state

Government Concern

- **Changing Waste Stream**. When local governments assumed responsibility for solid waste, it consisted mostly of coal ash left over from heating and cooking, food, paper and glass. Today, manufactured products make up 75% of what we throw away.
- **Cost.** California estimates that its local governments spend over $100,000,000 a year collecting and properly managing household hazardous products alone.

Human Health Concern

- The Average Cell Phone Contains
  - Lead (Pb)
  - Antimony (Sb)
  - Arsenic (As)
  - Beryllium (Be)

What to do at Your Product's End of Life?

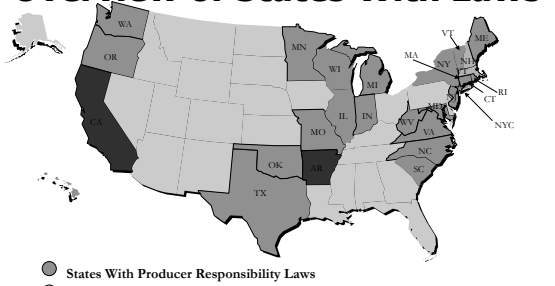
Could you be required
to take the product back?

Extended Producer Responsibility

Scale of E-Waste

- 2009
  - 53 million tons of electronics were discarded by consumers and businesses worldwide,
  - Only 13% was recycled
- Global e-waste generation is estimated as growing by 40 million tons per year

Overview of States With Laws



States With Producer Responsibility Laws
States With ARF (Consumer Fees) Laws
States With Landfill Disposal Fee
States With Disposal Ban/No E-Waste Law

As of June 2010

Canada

Status of Selected Provincial Environment Regulations
(as of April 2010)

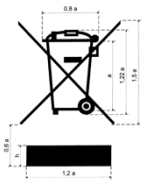
	BC	AB	SK	MB	ON	QU	NB	NS	PEI	NF
Phase I Electronics (displays, computers, printers)	●	●	●	● April 2011	●	★	★	●	● July 2010	★
Phase II Electronics (home, vehicle & portable Audio Video and selected telecomm)	● July 2010	★	● April 2010	●* April 2011	●* April 2010	★	■	●	● July 2010	■
Phase III Electronics (photocopiers/printers, gaming consoles, servers, peripherals)	● July 2012	■	■	● April 2011	■	■	■	■	■	■
Batteries (rechargeable & non-rechargeable)	● July 2010	■	■	● April 2011	●	★	■	■	■	■

● Regulations currently in place (* includes copiers)
★ Regulations drafted / expected in 2010
■ Regulations not expected until 2011 or later

SWEEP ACES ESABC

E-Waste in the EU

- The 2003 EU Directive on **Waste from Electrical and Electronic Equipment (WEEE)**



WEEE Directive Requirements

1. Product design
2. Separate collection
3. Treatment
4. Recovery
5. Financing
6. Marking, information, and reporting

Implementation Gaps

- EU Member states have failed to implement WEEE to improve recycling rates.
- Unknown where 50-60% of European e-waste goes, only 30% is officially recycled and 12% end up in landfills.
- Illegal Export.

Needle in a Haystack

- More than 9 million containers pass through Rotterdam each year.
- The EU banned the trade in illegal e-waste exports in the mid-1990s.
- Dutch customs officials select shipments through risk profiling.
- Only 3% of containers are checked. In a week only 1 illegal e-waste shipment may be caught.

Summary

Thank you

Leona Lewis

Resources

- *The Problem is Manufactured Product Waste,* California Product Stewardship Council http://www.calpsc.org/solution/problem.html
- *Europe breaking electronic waste export ban*, BBC News Europe, August 4, 2010 http://www.bbc.co.uk/news/world-europe-10846395
- *ELECTRONIC WASTE: Considerations for Promoting Environmentally Sound Reuse and Recycling, U.S. Government Accountability Office,* July 2101 http://sp.bestbuy.com/corp/legal/compliance/environmental/Lists/Announcements/Attachments/157/GAO%20Report%20on%20E-Waste%20July%202010.pdf
- Summary on EU Directive on Waste Electrical and Electronic Equipment (WEEE), Europa, http://europa.eu/legislation_summaries/environment/waste_management/l21210_en.htm
- Canadian E-Waste Programs www.eStewardship.ca

More Resources

- *MEPs want curbs on illegal e-waste shipments***,** EurActive Network, June 23, 2010 http://www.euractiv.com/en/sustainability/MEPs-want-cuts-illegal-e-waste-shipments-news-495483
- *Analysts slam EU's e-waste recast*, EurActive Network, *March 2, 2010* http://www.euractiv.com/en/sustainability/researchers-say-e-waste-recast-ingnores-elephants-room-news-299821
- *Urgent Need to Prepare Developing Countries for Surge in E-Wastes*, United Nations Environment Programme, February 22, 2010 http://www.unep.org/Documents.Multilingual/Default.asp?DocumentID=612&ArticleID=6471&l=en&t=long
- California Department of Toxic Substances Control www.dtsc.ca.gov

Even More Resources

- National Electronic Recycling Infrastructure Clearinghouse www.ecyclingresource.org
- Basel Action Network http://www.ban.org/
- *The Afterlife of Cellphones*, Jon Mooallem, New York Times, January 13, 2008 http://query.nytimes.com/gst/fullpage.html?res=980DE1DD1F3CF930A25752C0A96E9C8B63

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Beyond The Factory Door: Environmental Issues After The Product Leaves The Factory

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Issue Sampler

1. Chemical Composition Regulation
2. SEC Global Warming Guidance
3. Life-cycle Assessment

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Chemical Composition Restrictions

- Who
  - EU: **R**egistration, **E**valuation, **A**uthorisation and Restriction of **Ch**emical substances (REACH)
  - Japan: **C**hemical **S**ubstances **C**ontrol **L**aw (CSCL)
  - US **T**oxic **S**ubstances **C**ontrol **A**ct (TSCA)
  - Company and Industry “black” lists

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Chemical Composition Restrictions

- What (an example)
  - "The REACH Regulation gives greater responsibility to industry to manage the risks from chemicals and to provide safety information on the substances."
  - "The Regulation also calls for the progressive substitution of the most dangerous chemicals when suitable alternatives have been identified."

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SEC Climate Change Interpretive Guidance

Examples where climate change may trigger disclosure:

- **Direct Impact of Regulation:** impact of laws and regulations regarding climate change.
- **Indirect Impacts of Regulation or Business Trends:** indirect consequences of climate change related regulatory or business trends (e.g., decreased demand for goods that produce significant GHG emissions).
- **Physical Impacts of Climate Change:** actual and potential material impacts of environmental matters on their business.

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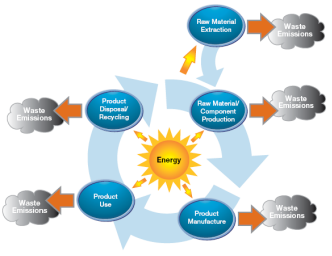
Environmental Life-cycle Assessments

"life cycle assessment - methodology developed to assess a product's full environmental costs, from raw material to final disposal."

http://www.nrdc.org/reference/glossary/l.asp



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What makes this different? Why now?

1960s ~ 1990s	1990s ~ NOW
• Problems local, immediate (burning rivers…)	→ Problems more global, distant (drowning polar bears…)
• Focus on factories (smokestacks, drain pipes)	→ Focus shifting to products (hybrids, biofuels, ODI)
• Focus on individual chemicals (chlorine)	→ Focus shifting to environmental impacts (human toxicity)
• Adversarial / quasi-religious (good v. evil)	→ More pragmatic, cooperative (potential NGO allies)
• Command + Control (nothing but cost… make it go away…)	→ Quantification + monetization of environmental benefits
• No value to customers	*Customers now engaged*
• Stovepiped w/i (Ops+HSE)	*Businesses now engaged*

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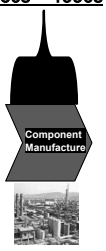
What makes this different? Why now?
1960s ~ 1990s 1990s ~ NOW



Retail

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What makes this different? Why now?
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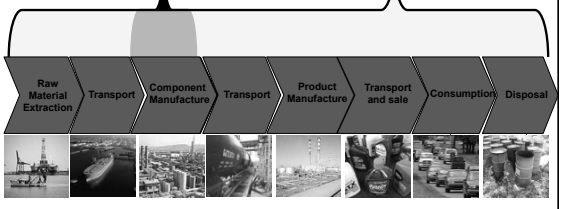

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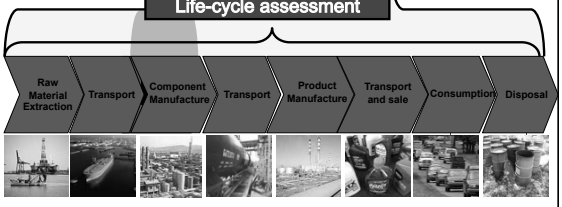

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LCA – "Why"

- Defensive: attacks, meetcomp
- Proactive: market perceptions
- Marketing
  - Quantify → monetize environmental value
  - Protect against "Greenwash"
- Customer requirement
- Corporate / Brand positioning

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LCAs protect marketing claims from "greenwash" attacks by identifying unintended burden shifting:

- ☑ Increasing one impact while decreasing another impact
- ☑ Shifting impact from one life-cycle stage to another
- ☑ Shifting impacts "outside the gate"

Impact	Manufacturing	Product Use	End of Life
Resource Depletion			
Global Warming			
Human Toxicity			
Acidification			

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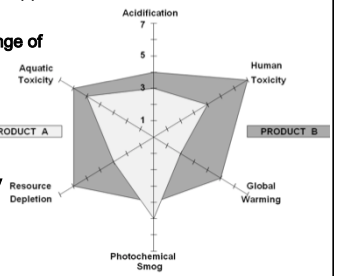
LCAs enable a new, fresh approach to environmental marketing by:

- ☑ Emphasizing a wide range of environmental impacts, not just one or two.
- ☑ Enabling a richer more extensive quantification and comparison of product benefits than previously achievable.



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Additional Information

http://www.epa.gov/oppt/existingchemicals/pubs/enhanchems.html

http://echa.europa.eu/reach/faq_en.asp

http://www.un.org/esa/dsd/dsd_aofw_ni/ni_pdfs/NationalReports/japan/Chemicals.pdf

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Environmental Marketing

1. Environmental Marketing – What is it?
2. Why do it?
3. Greenwash – What is it?
4. Why do we care?

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Environmental Marketing – what is it?

(Type I): a label or mark authorized by a third party.

awarded by third party based upon product meeting certain criteria pre-established for a given product category. Example: German *Blue Angel* seal.

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Environmental Marketing – what is it?

(Type II): a self-declared claim involving limited environmental elements.

made by a manufacturer based upon a product's performance against one or more limited environmental attributes based on life-cycle consideration. Examples: "recyclable", "recycled content", "reduced resource use", "recovered energy", "waste reduction", "reduced energy consumption", "designed for disassembly", "compostable" and "degradable".

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Environmental Marketing – what is it?

(Type III): an environmental declaration based on the entire product life cycle.

made by a manufacturer based upon the entire life-cycle assessment for a given product.
Example: a data sheet showing the life-cycle performance of a given product over a range of environmental impacts such as human toxicity, aquatic toxicity, photochemical smog formation, acidification, resource depletion, eutrophication and climate change.

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Environmental Marketing – why do it?

- **Investor demand**
- **Customer demand**
- **Meet comp**
- **Product differentiation**
- **Brand enhancement**
- **New market development**

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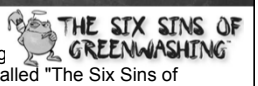
Greenwash-what is it?



Dec 2007, environmental marketing firm TerraChoice publishes study called "The Six Sins of Greenwashing". +99% of 1,018 common consumer products randomly surveyed were guilty of greenwashing.

#1. **Sin of the Hidden Trade-Off**: e.g. "Energy-efficient" electronics that contain hazardous materials. 57% of claims.

#2. **Sin of No Proof**: e.g. shampoos claiming to be "certified organic," but with no verifiable certification. 26% of claims.

#3. **Sin of Vagueness**: e.g. claiming to be 100% natural when many naturally-occurring substances are hazardous. 11% of claims.

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Greenwash-what is it?

#4. **Sin of Irrelevance**: e.g. claiming to be CFC-free, even though CFCs were banned 20 years ago. 4% of claims.

#5. **Sin of Fibbing**: e.g. falsely claiming to be certified by an internationally recognized environmental standard like EcoLogo, Energy Star or Green Seal. <1% of claims.

#6. **Sin of Lesser of Two Evils**: e.g. organic cigarettes or "environmentally friendly" pesticides. 1% of claims.

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Greenwash-what is it?

4/09, TerraChoice new sin:

#7. **Sin of Worshiping False Labels**: giving the impression, through either words or images, of third-party endorsement where no such endorsement actually exists; fake labels, in other words.

2009 study pinpointed three areas of consumer goods with the greatest level of greenwashing: children products, cosmetics, cleaning products

In all three cases, marketers manipulate consumer safety concerns and fears by capitalizing on supposed health and safety benefits of “green” living.

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Greenwash-why should we care?

greenwashing detection kit

by Greenpeace

Since the 1992 Earth Summit, the number of corporations claiming to embrace the concept of "sustainable development" has risen sharply. This is evident from the number of advertisements which use images of pristine nature to sell a product, or claim outright that certain products or practices are "eco-friendly" and "sustainable"

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Greenwash - why should we care?

FTC Green Guidelines May Leave Marketers Red-Faced

Experts Say Pending Guides Could Upend Efforts, Make Some 300 Environmental Seals of Approval Unsustainable

By Jack Neff : August 23, 2010

BATAVIA, Ohio (AdAge.com) -- Attention marketers: Within the next few weeks, you may be recasting your entire green-marketing strategy.

Right now on the desks of Federal Trade Commissioners is the new set of so-called Green Guides that are used by the FTC to guide enforcement of existing laws. They are the first environmental-marketing guidelines in 12 years and could radically reshape how far marketers can go in painting their products, packaging or even corporate images green.

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Greenwash - why should we care?

EU Guidelines for Making and Assessing Environmental Claims

- Guidance published December 2000
- References ISO 14021:1999 now 2001
- Focused on 'self-declared' environmental claims
- Covers use of statements, symbols and graphics
- Aimed at ensuring truthful, clear and not misleading environmental claims
- Four guiding principles

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Four Guiding Principles

1. Self-declared environmental claims shall be accurate, verifiable, relevant, able to be substantiated and not misleading
2. Environmental claims shall be based on scientific methodology that is sufficiently thorough and comprehensive to support the claim and that produces accurate and reproducible results
3. Information concerning the procedure, methodology and any criteria used to support environmental claims shall be available and provided upon request to all interested parties
4. The formulation of environmental claims shall take into consideration all relevant aspects of the life cycle of the goods or service, although not necessarily considering a full life-cycle analysis

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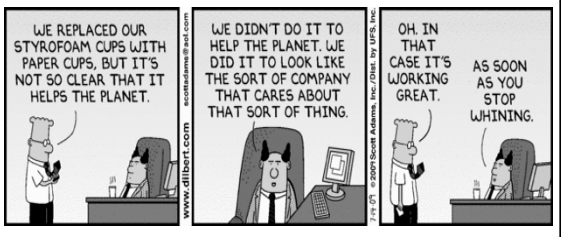


EPA/600/R-06/060
May 2006

LIFE CYCLE ASSESSMENT: PRINCIPLES AND PRACTICE

by

Scientific Applications International Corporation (SAIC)
11251 Roger Bacon Drive
Reston, VA 20190

Contract No. 68-C02-067
Work Assignment 3-15

Work Assignment Manager
Mary Ann Curran
Systems Analysis Branch
National Risk Management Research Laboratory
Cincinnati, Ohio 45268

NATIONAL RISK MANAGEMENT RESEARCH LABORATORY
OFFICE OF RESEARCH AND DEVELOPMENT
U.S. ENVIRONMENTAL PROTECTION AGENCY
CINCINNATI, OHIO 45268

Notice

The U.S. Environmental Protection Agency through its Office of Research and Development funded and managed the research described here under contract no. 68-C02-067 to Scientific Applications International Corporation (SAIC). It has been subjected to the Agency's review and has been approved for publication as an EPA document. Mention of trade names or commercial products does not constitute endorsement or recommendation for use. Use of this methodology does not imply EPA approval of the conclusions of any specific life cycle assessment.

Foreword

The U.S. Environmental Protection Agency (EPA) is charged by Congress with protecting the Nation's land, air, and water resources. Under a mandate of national environmental laws, the Agency strives to formulate and implement actions leading to a compatible balance between human activities and the ability of natural systems to support and nurture life. To meet this mandate, EPA's research program is providing data and technical support for solving environmental problems today and building a science knowledge base necessary to manage our ecological resources wisely, understand how pollutants affect our health, and prevent or reduce environmental risks in the future.

The National Risk Management Research Laboratory (NRMRL) is the Agency's center for investigation of technological and management approaches for preventing and reducing risks from pollution that threaten human health and the environment. The focus of the Laboratory's research program is on methods and their cost-effectiveness for prevention and control of pollution to air, land, water, and subsurface resources; protection of water quality in public water systems; remediation of contaminated sites, sediments and ground water; prevention and control of indoor air pollution; and restoration of ecosystems. NRMRL collaborates with both public and private sector partners to foster technologies that reduce the cost of compliance and to anticipate emerging problems. NRMRL's research provides solutions to environmental problems by: developing and promoting technologies that protect and improve the environment; advancing scientific and engineering information to support regulatory and policy decisions; and providing the technical support and information transfer to ensure implementation of environmental regulations and strategies at the national, state, and community levels.

This publication has been produced as part of the Laboratory's strategic long-term research plan. It is published and made available by EPA's Office of Research and Development to assist the user community and to link researchers with their clients.

Sally Gutierrez, Director
National Risk Management Research Laboratory

Abstract

The following document provides an introductory overview of Life Cycle Assessment (LCA) and describes the general uses and major components of LCA. This document is an update and merger of two previous EPA documents on LCA ("Life Cycle Assessment: Inventory Guidelines and Principles," EPA/600/R-92/245, and "LCA101" from the *LCAccess*, website, http://www.epa.gov/ORD/NRMRL/lcaccess). It presents the four basic stages of conducting an LCA: goal and scope definition, inventory analysis, impact assessment, and improvement analysis. The major stages in an LCA study are raw material acquisition, materials manufacture, production, use/reuse/maintenance, and waste management. The system boundaries, assumptions, and conventions to be addressed in each stage are presented. This document is designed to be an educational tool for someone who wants to learn the basics of LCA, how to conduct an LCA, or how to manage someone conducting an LCA. Companies, federal facilities, industry organizations, or academia can benefit from learning how to incorporate environmental performance based on the life cycle concept into their decision-making processes. This report was submitted in fulfillment of contract 68-C02-067 by Scientific Applications International Corporation (SAIC) under the sponsorship of the United States Environmental Protection Agency. This report covers a period from December 2005 to May 2006, and work was completed as of May 30, 2006.

Contents

Exhibits

Tables

Abbreviations

BOD	biological oxygen demand
Btu	British thermal unit
CO	carbon monoxide
COD	chemical oxygen demand
CO_2	carbon dioxide
DQIs	data quality indicators
EPA	United States Environmental Protection Agency
GWh	gigawatt-hour
ISO	International Standards Organization (International Organization of Standardization)
kWh	kilowatt-hour
LCA	life cycle assessment
LCI	life cycle inventory
LCIA	life cycle impact assessment
LCM	life cycle management
MJ	megajoule
NO_2	nitrogen dioxide
NRMRL	National Risk Management Research Laboratory
REPA	Resource and Environmental Profile Analysis
SETAC	Society of Environmental Toxicology and Chemistry
SO_2	sulfur dioxide
TRACI	Tool for the Reduction and Assessment of Chemical and other environmental Impacts
TRI	Toxics Release Inventory
VOCs	volatile organic compounds

Chapter 1
Life Cycle Assessment

What is Life Cycle Assessment (LCA)?

As environmental awareness increases, industries and businesses are assessing how their activities affect the environment. Society has become concerned about the issues of natural resource depletion and environmental degradation. Many businesses have responded to this awareness by providing "greener" products and using "greener" processes. The environmental performance of products and processes has become a key issue, which is why some companies are investigating ways to minimize their effects on the environment. Many companies have found it advantageous to explore ways of moving *beyond* compliance using pollution prevention strategies and environmental management systems to improve their environmental performance. One such tool is LCA. This concept considers the entire life cycle of a product (Curran 1996).

Life cycle assessment is a "cradle-to-grave" approach for assessing industrial systems. "Cradle-to-grave" begins with the gathering of raw materials from the earth to create the product and ends at the point when all materials are returned to the earth. LCA evaluates all stages of a product's life from the perspective that they are interdependent, meaning that one operation leads to the next. LCA enables the estimation of the cumulative environmental impacts resulting from all stages in the product life cycle, often including impacts not considered in more traditional analyses (e.g., raw material extraction, material transportation, ultimate product disposal, etc.). By including the impacts throughout the product life cycle, LCA provides a comprehensive view of the environmental aspects of the product or process and a more accurate picture of the true environmental trade-offs in product and process selection.

The term "life cycle" refers to the major activities in the course of the product's life-span from its manufacture, use, and maintenance, to its final disposal, including the raw material acquisition required to manufacture the product. Exhibit 1-1 illustrates the possible life cycle stages that can be considered in an LCA and the typical inputs/outputs measured.

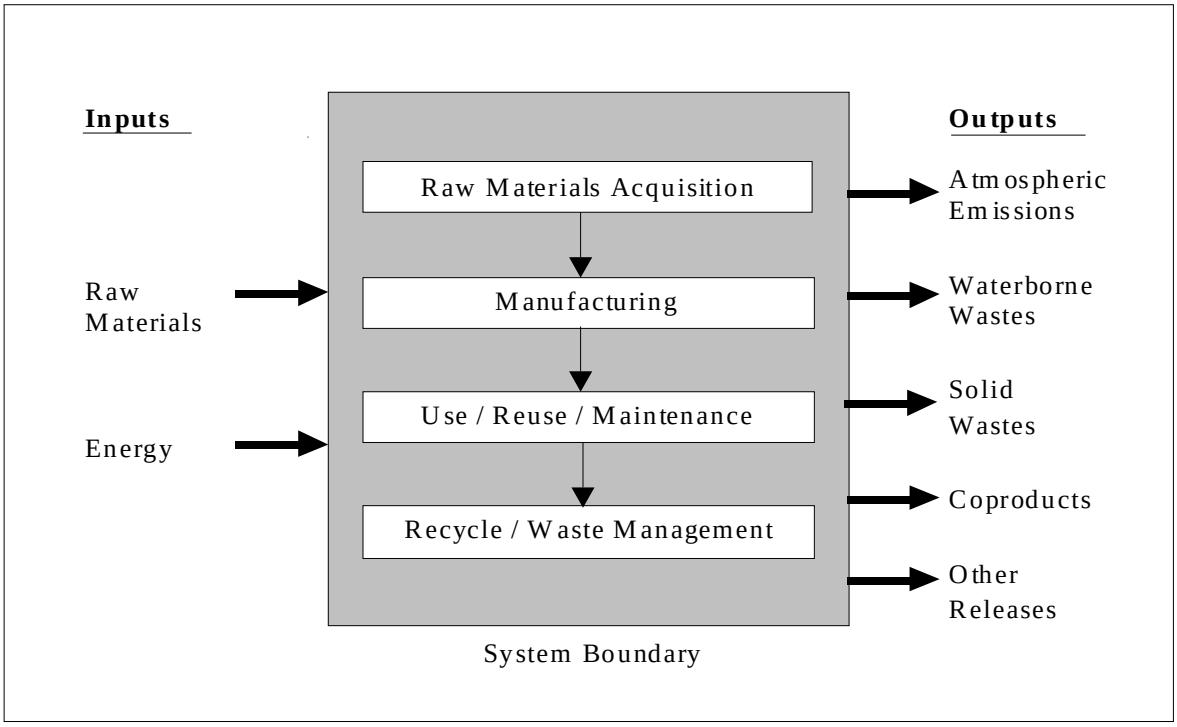


Exhibit 1-1. Life Cycle Stages (Source: EPA,1993)

Specifically, LCA is a technique to assess the environmental aspects and potential impacts associated with a product, process, or service, by:

- Compiling an inventory of relevant energy and material inputs and environmental releases
- Evaluating the potential environmental impacts associated with identified inputs and releases
- Interpreting the results to help decision-makers make a more informed decision.

The LCA process is a systematic, phased approach and consists of four components: goal definition and scoping, inventory analysis, impact assessment, and interpretation as illustrated in Exhibit 1-2:

1. *Goal Definition and Scoping* - Define and describe the product, process or activity. Establish the context in which the assessment is to be made and identify the boundaries and environmental effects to be reviewed for the assessment.

2. *Inventory Analysis* - Identify and quantify energy, water and materials usage and environmental releases (e.g., air emissions, solid waste disposal, waste water discharges).

3. *Impact Assessment* - Assess the potential human and ecological effects of energy, water, and material usage and the environmental releases identified in the inventory analysis.

4. *Interpretation* - Evaluate the results of the inventory analysis and impact assessment to select the preferred product, process or service with a clear understanding of the uncertainty and the assumptions used to generate the results.

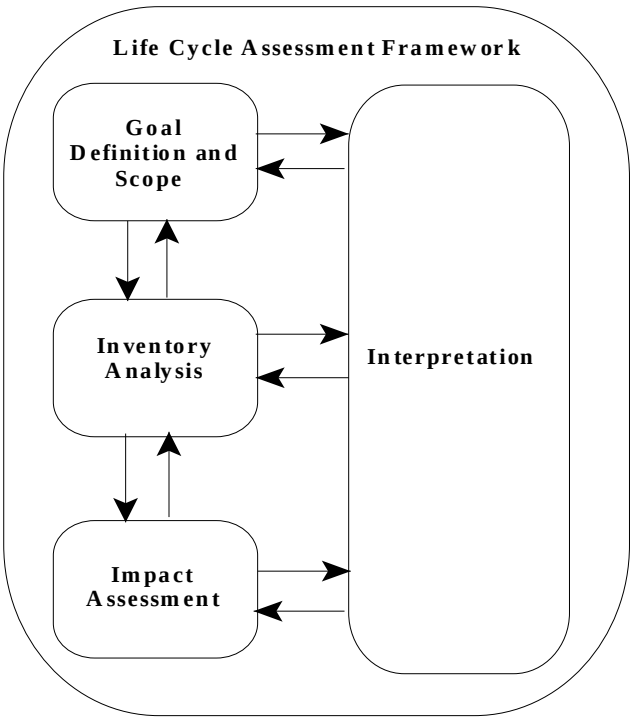


Exhibit 1-2. Phases of an LCA (Source: ISO, 1997)

Life cycle assessment is unique because it encompasses all processes and environmental releases beginning with the extraction of raw materials and the production of energy used to create the product through the use and final disposition of the product. When deciding between two or more alternatives, LCA can help decision-makers compare all major environmental impacts caused by products, processes, or services.

What Are the Benefits of Conducting an LCA?

An LCA can help decision-makers select the product or process that results in the least impact to the environment. This information can be used with other factors, such as cost and performance data to select a product or process. LCA data identifies the transfer of environmental impacts from one media to another (e.g., eliminating air emissions by creating a wastewater effluent instead) and/or from one life cycle stage to another (e.g., from use and reuse of the product to the raw material acquisition phase). If an LCA were not performed, the transfer might not be recognized and properly included in the analysis because it is outside of the typical scope or focus of product selection processes.

LCA Helps to Avoid Shifting Environmental Problems from One Place to Another

An LCA allows a decision maker to study an entire product system hence avoiding the sub-optimization that could result if only a single process were the focus of the study. For example, when selecting between two rival products, it may appear that Option 1 is better for the environment because it generates less solid waste than Option 2. However, after performing an LCA it might be determined that the first option actually creates larger cradle-to-grave environmental impacts when measured across all three media (air, water, land) (e.g., it may cause more chemical emissions during the manufacturing stage). Therefore, the second product (that produces solid waste) may be viewed as producing less cradle-to-grave environmental harm or impact than the first technology because of its lower chemical emissions.

This ability to track and document shifts in environmental impacts can help decision makers and managers fully characterize the environmental trade-offs associated with product or process alternatives. By performing an LCA, analysts can:

- Develop a systematic evaluation of the environmental consequences associated with a given product.
- Analyze the environmental trade-offs associated with one or more specific products/processes to help gain stakeholder (state, community, etc.) acceptance for a planned action.
- Quantify environmental releases to air, water, and land in relation to each life cycle stage and/or major contributing process.
- Assist in identifying significant shifts in environmental impacts between life cycle stages and environmental media.
- Assess the human and ecological effects of material consumption and environmental releases to the local community, region, and world.
- Compare the health and ecological impacts between two or more rival products/processes or identify the impacts of a specific product or process.
- Identify impacts to one or more specific environmental areas of concern.

A Brief History of Life-Cycle Assessment

Life Cycle Assessment (LCA) had its beginnings in the 1960's. Concerns over the limitations of raw materials and energy resources sparked interest in finding ways to cumulatively account for energy use and to project future resource supplies and use. In one of the first publications of its kind, Harold Smith reported his calculation of cumulative energy requirements for the production of chemical intermediates and products at the World Energy Conference in 1963.

Later in the 1960's, global modeling studies published in *The Limits to Growth* (Meadows *et al* 1972) and *A Blueprint for Survival* (Goldsmith *et al* 1972) resulted in predictions of the effects of the world's changing populations on the demand for finite raw materials and energy resources. The predictions for rapid depletion of fossil fuels and climatological changes resulting from excess waste heat stimulated more detailed calculations of energy use and output in industrial processes. During this period, about a dozen studies were performed to estimate costs and environmental implications of alternative sources of energy.

In 1969, researchers initiated an internal study for The Coca-Cola Company that laid the foundation for the current methods of life cycle inventory analysis in the United States. In a comparison of different beverage containers to determine which container had the lowest releases to the environment and least affected the supply of natural resources, this study quantified the raw materials and fuels used and the environmental loadings from the manufacturing processes for each container. Other companies in both the United States and Europe performed similar comparative life cycle inventory analyses in the early 1970's. At that time, many of the available sources were derived from publicly-available sources such as government documents or technical papers, as specific industrial data were not available.

The process of quantifying the resource use and environmental releases of products became known as a Resource and Environmental Profile Analysis (REPA), as practiced in the United States. In Europe, it was called an Ecobalance. With the formation of public interest groups encouraging industry to ensure the accuracy of information in the public domain, and with the oil shortages in the early 1970's, approximately 15 REPAs were performed between 1970 and 1975. Through this period, a protocol or standard research methodology for conducting these studies was developed. This multi-step methodology involves a number of assumptions. During these years, the assumptions and techniques used underwent considerable review by EPA and major industry representatives, with the result that reasonable methodologies were evolved.

From 1975 through the early 1980's, as interest in these comprehensive studies waned because of the fading influence of the oil crisis, environmental concerns shifted to issues of hazardous and household waste management. However, throughout this time, life cycle inventory analysis continued to be conducted and the methodology improved through a slow stream of about two studies per year, most of which focused on energy requirements. During this time, European interest grew with the establishment of an Environment Directorate (DG X1) by the European Commission. European LCA practitioners developed approaches parallel to those being used in the USA. Besides working to standardize pollution regulations throughout Europe, DG X1 issued the Liquid Food Container Directive in 1985, which charged member companies with monitoring the energy and raw materials consumption and solid waste generation of liquid food containers.

When solid waste became a worldwide issue in 1988, LCA again emerged as a tool for analyzing environmental problems. As interest in all areas affecting resources and the environment grows, the methodology for LCA is again being improved. A broad base of consultants and researchers across the globe has been further refining and expanding the methodology. The need to move beyond the inventory to impact assessment has brought LCA methodology to another point of evolution (SETAC 1991; SETAC 1993; SETAC 1997).

In 1991, concerns over the inappropriate use of LCAs to make broad marketing claims made by product manufacturers resulted in a statement issued by eleven State Attorneys General in the USA denouncing the use of LCA results to promote products until uniform methods for conducting such assessments are developed and a consensus reached on how this type of environmental comparison can be advertised non-deceptively. This action, along with pressure from other environmental organizations to standardize LCA methodology, led to the development of the LCA standards in the International Standards Organization (ISO) 14000 series (1997 through 2002).

In 2002, the United Nations Environment Programme (UNEP) joined forces with the Society of Environmental Toxicology and Chemistry (SETAC) to launch the Life Cycle Initiative, an international partnership. The three programs of the Initiative aim at putting life cycle thinking into practice and at improving the supporting tools through better data and indicators. The Life Cycle Management (LCM) program creates awareness and improves skills of decision-makers by producing information materials, establishing forums for sharing best practice, and carrying out training programs in all parts of the world. The Life Cycle Inventory (LCI) program improves global access to transparent, high quality life cycle data by hosting and facilitating expert groups whose work results in web-based information systems. The Life Cycle Impact Assessment (LCIA) program increases the quality and global reach of life cycle indicators by promoting the exchange of views among experts whose work results in a set of widely accepted recommendations.

Limitations of Conducting an LCA

Performing an LCA can be resource and time intensive. Depending upon how thorough an LCA the user wishes to conduct, gathering the data can be problematic, and the availability of data can greatly impact the accuracy of the final results. Therefore, it is important to weigh the availability of data, the time necessary to conduct the study, and the financial resources required against the projected benefits of the LCA.

LCA will not determine which product or process is the most cost effective or works the best. Therefore, the information developed in an LCA study should be used as one component of a more comprehensive decision process assessing the trade-offs with cost and performance, e.g., Life Cycle Management.

Life Cycle Management

Life Cycle Management (LCM) is the application of life cycle thinking to modern business practice, with the aim to manage the total life cycle of an organization's product and services toward more sustainable consumption and production (Jensen and Remmen 2004). It is an integrated framework of concepts and techniques to address environmental, economic, technological, and social aspects of products, services, and organizations. LCM, as any other management pattern, is applied on a voluntary basis and can be adapted to the specific needs and characteristics of individual organizations (SETAC 2004).

There are a number of ways to conduct Life Cycle Impact Assessment. While the methods are typically scientifically-based, the complexity of environmental systems has led to the development of alternative impact models. Chapter 4 expands on this.

As mentioned earlier, an LCA can help identify potential environmental tradeoffs. However, converting the impact results to a single score requires the use of value judgments, which must be applied by the commissioner of the study or the modeler. This can be done in different ways such as through the use of an expert panel, but it cannot be done based solely on natural science.

Chapter 2
Goal Definition and Scoping

What is Goal Definition and Scoping?

Goal definition and scoping is the phase of the LCA process that defines the purpose and method of including life cycle environmental impacts into the decision-making process. In this phase, the following items must be determined: the type of information that is needed to add value to the decision-making process, how accurate the results must be to add value, and how the results should be interpreted and displayed in order to be meaningful and usable.

How Does Goal Definition and Scoping Affect the LCA Process?

The LCA process can be used to determine the potential environmental impacts from any product, process, or service. The goal definition and scoping of the LCA project will determine the time and resources needed. The defined goal and scope will guide the entire process to ensure that the most meaningful results are obtained. Every decision made throughout the goal definition and scoping phase impacts either how the study will be conducted, or the relevance of the final results. The following section identifies the decisions that must be made at the beginning of the LCA study and the impact of these decisions on the LCA process.

Getting Started

The following six basic decisions should be made at the beginning of the LCA process to make effective use of time and resources:

1. Define the Goal(s) of the Project
2. Determine What Type of Information Is Needed to Inform the Decision-Makers
3. Determine the Required Specificity
4. Determine How the Data Should Be Organized and the Results Displayed
5. Define the Scope of the Study
6. Determine the Ground Rules for Performing the Work

Each decision and its associated impact on the LCA process are explained below in further detail.

Define the Goal(s) of the Project

LCA is a versatile tool for quantifying the overall (cradle-to-grave) environmental impacts from a product, process, or service. The primary goal is to choose the best product, process, or service with the least effect on human health and the environment. Conducting an LCA also can help guide the development of new products, processes, or activities toward a net reduction of resource requirements and emissions. There may also be secondary goals for performing an LCA, which would vary depending on the type of project. The following are examples of possible applications for life-cycle inventories, most of which require some level of impact assessment in addition to the inventory:

- *Support broad environmental assessments* - The results of an LCA are valuable in understanding the relative environmental burdens resulting from evolutionary changes in given processes, products, or packaging over time; in understanding the relative environmental burdens between alternative processes or materials used to make, distribute, or use the same product; and in comparing the environmental aspects of alternative products that serve the same use.

- *Establish baseline information for a process* - A key application of an LCA is to establish a baseline of information on an entire system given current or predicted practices in the manufacture, use, and disposal of the product or category of products. In some cases, it may suffice to establish a baseline for certain processes associated with a product or package. This baseline would consist of the energy

and resource requirements and the environmental loadings from the product or process systems that are analyzed. The baseline information is valuable for initiating improvement analysis by applying specific changes to the baseline system.

- *Rank the relative contribution of individual steps or processes* - The LCA results provide detailed data regarding the individual contributions of each step in the system studied to the total system. The data can provide direction to efforts for change by showing which steps require the most energy or other resources, or which steps contribute the most pollutants. This application is especially relevant for internal industry studies to support decisions on pollution prevention, resource conservation, and waste minimization opportunities.

- *Identify data gaps* - The performance of an LCA for a particular system reveals areas in which data for particular processes are lacking or are of uncertain or questionable quality. Inventory followed by impact assessment aids in identifying areas where data augmentation is appropriate for both stages.

- *Support public policy* - For the public policymaker, LCA can help broaden the range of environmental issues considered in developing regulations or setting policies.

- *Support product certification* - Product certifications have tended to focus on relatively few criteria. LCA, only when applied using appropriate impact assessment, can provide information on the individual, simultaneous effects of many product attributes.

- *Provide information and direction to decision-makers* - LCA can be used to inform industry, government, and consumers on the tradeoffs of alternative processes, products, and materials. The data can give industry direction in decisions regarding production materials and processes and create a better informed public regarding environmental issues and consumer choices.

- *Guide product and process development* - LCA can help guide manufacturers in the development of new products, processes, and activities toward a net reduction of resource requirements and emissions.

Determine What Type of Information Is Needed to Inform the Decision-Makers

LCA can help answer a number of important questions. Identifying the questions that the decision-makers care about will help define the study parameters. Some examples include:

- What is the impact to particular interested parties and stakeholders?
- Which product or process causes the least environmental impact (quantifiably) overall or in each stage of its life cycle?
- How will changes to the current product/process affect the environmental impacts across all life cycle stages?
- Which technology or process causes the least amount of acid rain, smog formation, or damage to local trees (or any other impact category of concern)?
- How can the process be changed to reduce a specific environmental impact of concern (e.g., global warming)?

Once the appropriate questions are identified, it is important to determine the types of information needed to answer the questions.

Attributional LCA versus Consequential LCA

During a workshop held in 2003, specifically on life cycle inventory for electricity generation, participants recognized the need to choose an allocation method depending considerably upon whether the life cycle assessment is being performed from an *attributional* or a *consequential* point of view. The term "attributional life cycle assessment" was defined as an attempt to answer "how are things (i.e. pollutants, resources, and exchanges among processes) flowing within the chosen temporal window?" while "consequential life cycle assessment" attempts to answer "how will flows beyond the immediate system change in response to decisions?" For example, an attributional LCA would examine the consequences of using green power compared to conventional sources. A consequential LCA would consider the consequences of this choice in that only a certain amount of green power may be available to customers, causing some customers to buy conventional energy once the supply of greener sources was gone. The choice between conducting an attributional or a consequential assessment depends on the stated goal of the study (Curran, Mann, & Norris 2005).

Determine the Required Specificity

At the outset of every study, the level of specificity must be decided. In some cases, this level will be obvious from the application or intended use of the information. In other instances, there may be several options to choose from, ranging from a completely generic study to one that is product-specific in every detail. Most studies fall somewhere in between.

An LCA can be envisioned as a set of linked activities that describe the creation, use, and ultimate disposal of the product or material of interest. At each life cycle stage, the analyst should begin by answering a series of questions: Is the product or system in the life cycle stage specific to one company or manufacturing operation? Or does the product or system represent common products or systems generally found in the marketplace and produced or used by a number of companies?

Such questions help determine whether data collected for the inventory should be specific to one company or manufacturing facility, or whether the data should be more general to represent common industrial practices.

The appropriate response to these questions often rests on whether the life cycle is being performed for internal organizational use or for a more public purpose. Accessibility to product- or facility-specific data may also be a factor. A company may be more interested in examining its own formulation and assembly operations, whereas an industry group or government agency may be more interested in characterizing industry-wide practice. LCAs can have a mix of product-specific and industry-average information. For example, a cereal manufacturer performing an analysis of using recycled paperboard for its cereal boxes might apply the following logic. For operations conducted by the manufacturer, such as box printing, set up, and filling, data specific to the product would be obtained because average data for printing and filling across the cereal industry or for industry in general would not be as useful.

Stepping back one stage to package manufacturing, the cereal manufacturer is again faced with the specificity decision. The data could be product-specific, or generic data for the manufacturing stage could be used. The product-specific approach has these advantages: the aggregated data reflect the operations of the specific paper mills supplying the recycled board, and the energy and resources associated with this stage can be compared with those of similar specificity for the filling, packaging, and distribution stage. A limitation of this option is the additional cost and time associated with collecting

product-specific data from the mills and the level of cooperation that needs to be established with the upstream vendors. Long-term confidentiality agreements with vendors may also represent unacceptable burdens compared with the value added by the more specific data.

Determine the Data Requirements

The required level of data accuracy for the project depends on the use of the final results and the intended audience (i.e. will the results be used to support decision-making in an internal process or in a public forum?). For example, if the intent is to use the results in a public forum to support product/process selection to a local community or regulator, then estimated data or best engineering judgment for the primary material, energy, and waste streams may not be sufficiently accurate to justify the final conclusions. In contrast, if the intent of performing the LCA is for internal decision-making purposes only, then estimates and best engineering judgment may be applied more frequently. This may reduce the overall cost and time required to perform the LCA, as well as enable completion of the study in the absence of precise, first-hand data.
In addition to the intended audience, the required level of data accuracy could be based on the criticality of the decision to be made and the amount of money involved in the decision.

The alternative decision path, using industrial average data for making recycled paperboard, has a parallel mix of advantages and limitations. Use of average, or generic, data may be advantageous for a manufacturer considering use of recycled board for which no current vendors have been identified. If the quality of these average data can be determined and is acceptable, their use may be preferable. The limitation is that data from this stage may be less comparable to that of more product-specific stages. This limitation is especially important in studies that mix product-specific and more general analyses in the same life-cycle stage. For example, comparing virgin and recycled paperboard using product-specific data for one material and generic data for the other could be problematic.

Another limitation is that the generic data may mask technologies that are more environmentally burdensome. Even with some measure of data variability, a decision to use a particular material made on the basis of generic data may misrepresent true loadings of the actual suppliers. Opportunities to identify specific facilities operating in a more environmentally sound manner are lost. Generic data do not necessarily represent industry-wide practices. The extent of representation depends on the quality and coverage of the available data and is impossible to state as a general rule.

It is recommended that the level of specificity be very clearly defined and communicated so that readers are more able to understand the differences in the final results. Before initiating data collection and periodically throughout the study, the analyst should revisit the specificity decision to determine if the approach selected for each stage remains valid in view of the intended use.

Foreground and Background Data

An important element in LCA practice is the distinction that has been made between foreground and background data. The foreground system refers to the system of primary concern. The background system delivers energy and materials to the foreground system as aggregated data sets in which individual plants and operations are not identified. The selection of foreground or background data decides if either marginal or average data are to be used.

Determine How the Data Should Be Organized and the Results Displayed
LCA practitioners define how data should be organized in terms of a *functional unit* that appropriately describes the function of the product or process being studied. Careful selection of the functional unit to measure and display the LCA results will improve the accuracy of the study and the usefulness of the results.

When an LCA is used to compare two or more products, the basis of comparison should be equivalent use, i.e., each system should be defined so that an equal amount of product or equivalent service is delivered to the consumer. In the handwashing example, if bar soap were compared to liquid soap, the logical basis for comparison would be an equal number of handwashings. Another example of equivalent use would be in comparing cloth diapers to disposable diapers. One type of diaper may typically be changed more frequently than the other, and market/use studies show that often cloth diapers are doubled, whereas disposables are not. Thus, throughout a day, more cloth diapers will be used. In this case, a logical basis for comparison between the systems would be the total number of diapers used over a set period of time.

Equivalent use for comparative studies can often be based on volume or weight, particularly when the study compares packaging for delivery of a specific product. A beverage container study might consider 1,000 liters of beverage as an equivalent use basis for comparison, because the product may be delivered to the consumer in a variety of different-size containers having different life-cycle characteristics.

An Example of Selecting a Functional Unit

An LCA study comparing two types of wall insulation to determine environmental preferability must be evaluated on the same function, the ability to decrease heat flow. Six square feet of four-inch thick insulation Type A is not necessarily the same as six square feet of four-inch thick insulation Type B. Insulation type A may have an R factor equal to ten, whereas insulation type B may have an R factor equal to 20. Therefore, type A and B do not provide the same amount of insulation and cannot be compared on an equal basis. If Type A decreases heat flow by 80 percent, you must determine how thick Type B must be to also decrease heat flow by 80 percent.

Define the Scope of the Study
As Chapter 1 explained, an LCA includes all four stages of a product or process life cycle: raw material acquisition, manufacturing, use/reuse/maintenance, and recycle/waste management. These product stages are explained in more detail below. To determine whether one or all of the stages should be included in the scope of the LCA, the following must be assessed: the goal of the study, the required accuracy of the results, and the available time and resources. Exhibit 2-1 provides an example of life cycle stages that could be included in a project related to treatment technologies.

Raw Materials Acquisition
The life cycle of a product begins with the removal of raw materials and energy sources from the earth. For instance, the harvesting of trees or the mining of nonrenewable materials would be considered raw materials acquisition. Transportation of these materials from the point of acquisition to the point of processing is also included in this stage.

Manufacturing

During the manufacturing stage, raw materials are transformed into a product or package. The product or package is then delivered to the consumer. The manufacturing stage consists of three steps: materials manufacture, product fabrication, and filling/packaging/distribution.

Materials Manufacture - The materials manufacture step involves the activities that convert raw materials into a form that can be used to fabricate a finished product.

Product Fabrication - The product fabrication step takes the manufactured material and processes it into a product that is ready to be filled or packaged.

Filling/Packaging/Distribution - This step finalizes the products and prepares them for shipment. It includes all of the manufacturing and transportation activities that are necessary to fill, package, and distribute a finished product. Products are transported either to retail outlets or directly to the consumer. This stage accounts for the environmental effects caused by the mode of transportation, such as trucking and shipping.

Use/Reuse/Maintenance

This stage involves the consumer's actual use, reuse, and maintenance of the product. Once the product is distributed to the consumer, all activities associated with the useful life of the product are included in this stage. This includes energy demands and environmental wastes from both product storage and consumption. The product or material may need to be reconditioned, repaired or serviced so that it will maintain its performance. When the consumer no longer needs the product, the product will be recycled or disposed.

Recycle/Waste Management

The recycle/waste management stage includes the energy requirements and environmental wastes associated with disposition of the product or material.

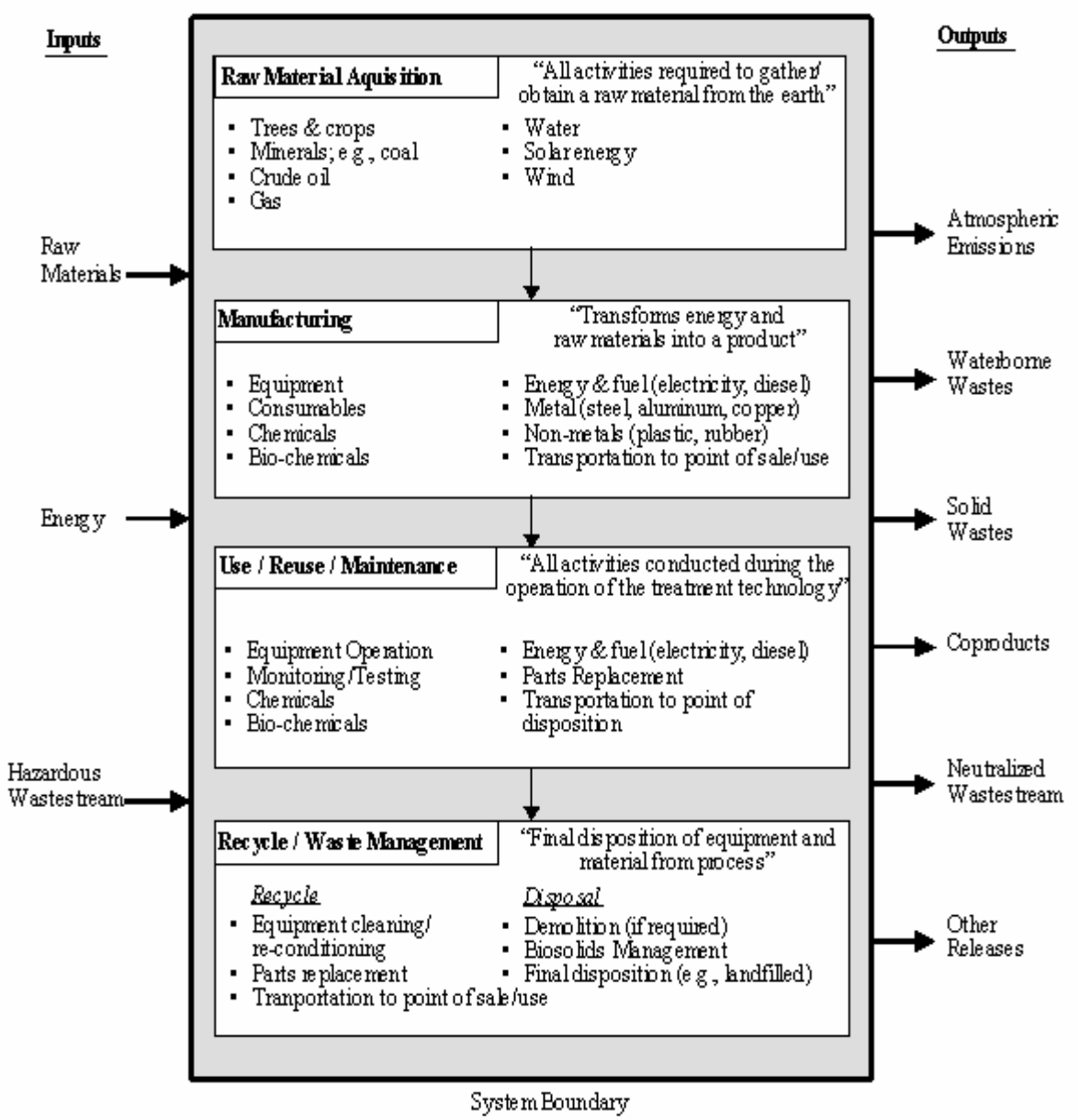


Exhibit 2-1. Sample Life Cycle Stages for a Treatment Project

Each step in the life cycle of a product, package, or material can be categorized within one and only one of these life-cycle stages. Each step or process can be viewed as a subsystem of the total product system. Viewing the steps as subsystems facilitates data gathering for the inventory of the system as a whole. The boundaries of subsystems are defined by life-cycle stage categories in Chapter 3. The rest of this chapter deals with defining boundaries of the whole product system. Many decisions must be made in defining the specific boundaries of each system.

Product systems are easier to define if the sequence of operations associated with a product or material is broken down into primary and secondary categories. The primary, or zero-order, sequence of activities directly contributes to making, using, or disposing of the product or material. The secondary category includes auxiliary materials or processes that contribute to making or doing something that in turn is in the primary activity sequence. Several tiers of auxiliary materials or processes may extend further and

further from the main sequence. In setting system boundaries, the analyst must decide where the analysis will be limited and be very clear about the reasons for the decision. The following questions are useful in setting and describing specific system boundaries:

- *Does the analysis need to cover the entire life cycle of the product?* A theoretically complete life-cycle system would start with all raw materials and energy sources in the earth and end with all materials back in the earth or at least somewhere in the environment but not part of the system. Any system boundary different from this represents a decision by the analyst to limit it in some way. Understanding the possible consequences of such decisions is important for evaluating tradeoffs between the ability of the resulting inventory to thoroughly address environmental attributes of the product constraints on cost, time, or other factors that may argue in favor of a more limited boundary. Too limited a boundary may exclude consequential activities or elements.

  Depending on the goal of the study, it is possible to exclude certain stages or activities and still address the issues for which the life-cycle assessment is being performed. For example, it may be possible to exclude the acquisition of raw materials without affecting the results. Suppose a company wishes to perform an LCA to evaluate alternative drying systems for formulating a snack food product. If the technologies are indifferent to the feedstock, it is possible to assume the raw materials acquisition stage will be identical for all options. If the decision will be based on selecting a drying system with lower energy use or environmental burdens, it may be acceptable to analyze such a limited system. However, with this system boundary, the degree of absolute differences in the overall system energy or environmental impact cannot be determined. The difference in the product manufacturing stage may represent a minor component of the total system. Therefore, statements about the total system cannot be made.

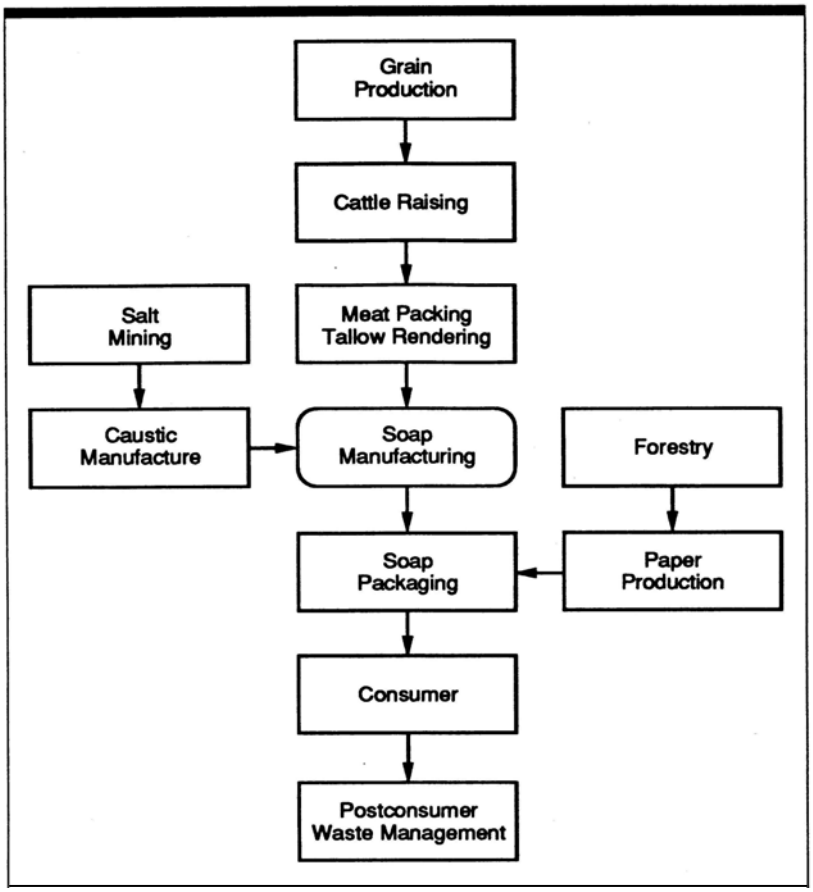
- *What will be the basis of use for the product or material?* Is the study intended to compare different product systems? If the products or processes are used at different rates, packaged in varying quantities, or come in different sizes, how can one accurately compare them? Can equivalent use ratios be developed? Should market shares be considered to estimate proportionate burden form each product in a given category? Is the study intended to compare service systems? Are the service functions clearly defined so that the input and outputs are properly proportioned?

- *What ancillary materials or chemicals are used to make or package the products or run the processes?* Might these ancillary materials or chemicals contribute more than a minor fraction of the energy or emissions of the system to be analyzed? How do they compare by weight with other materials and chemicals in the product systems?

- *In a comparative analysis, are any extra products required to allow one product to deliver equivalent or similar performance to another?* Are any extra materials or services required for one service to be functionally equivalent to another or to a comparable product?

Exhibit 2-2 shows an example of setting system boundaries for a product baseline analysis for a hypothetical bar soap system. Tallow is the major raw material for soap production, and its primary raw material source is the grain fed to cattle. Production of paper for packaging soap is also included. The fate of both the soap and its packaging end the life cycle of this system. Minor inputs could include, for example, the energy required to fabricate the tires on the combine used to plant and harvest the grain.

Exhibit 2-2. Example Flow Diagram of a Hypothetical Bar Soap System



In an LCA to create a baseline for future product development or improvement, the unit upon which the analysis is performed can be almost anything that produces internally consistent data. In the bar soap example, one possible usage unit could be a single bar. However, if the product packaging were being analyzed at the same time, it would be important for consistency to consider packaging in different amounts such as single bars, three-packs, and so on.

If the LCA were intended to analyze whether bar soap should be manufactured using an animal-derived or vegetable-derived raw material source, the system boundaries and units of analysis would be more complicated. First, the system flow diagram would have to be expanded to include the growing, harvesting, and processing steps for the alternative feedstock. Then the performance of the finished product would have to be considered. Do the options result in a bar that gets used up at different rates when one material or the other is chosen? If this were the case, a strict comparison of equal-weight bars would not be appropriate.

Suppose an analyst wants to compare bar soap made from tallow with a liquid hand soap made from synthetic ingredients. Because the two products have different raw material sources (cattle and petroleum), the analysis should begin with the raw materials acquisition step. Because the two products are packaged differently and may have different chemical formulas, the materials manufacture and packaging steps would need to be included. Consumer use and waste management options also should be examined because the different formulae could result in varying usage patterns. Thus for this comparative analysis, the analyst would have to inventory the entire life cycle of the two products.

Again, the analyst must determine the basis of comparison between the systems. Because one soap is a solid and the other is a liquid, each with different densities and cleansing abilities per unit amount, it would not make sense to compare them based on equal weights or volumes. The key factor is how much of each is used in one handwashing to provide an equivalent level of function or service. An acceptable basis for comparison might be equal numbers of handwashings. Because these two products may be used at different rates, it would be important to find data that give an equivalent use ratio. For example, a research lab study may show that five cubic millimeters of bar soap and ten cubic millimeters of liquid soap are used per handwashing. If the basis for comparison were chosen at 1,000 handwashings, 5,000 cubic millimeters of bar soap would be compared to 10,000 cubic millimeters of liquid soap. Thus, the equivalent use ratio is 1 to 2.

Because the two soap product types are packaged in different quantities and materials, the analyst would need to include packaging in the system. Contributions of extra ingredients, such as perfumes, might also be considered. The analyst may or may not find that any extra raw materials are used in one or the other. Soaps typically must meet a minimum standard performance level.

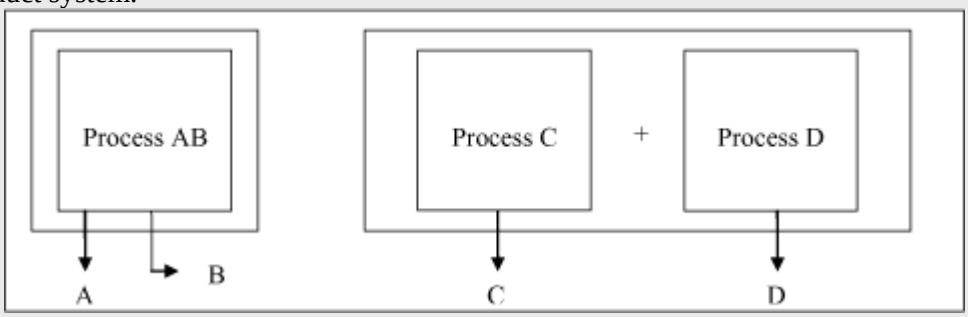
However, if the liquid hand soap also had a skin moisturizer in its formula, the analyst would need to include a moisturizing lotion product in the boundary of the bar soap system on two conditions. The first condition would apply if the environmental issues associated with this component were germane to the purpose of the LCA. The second condition, which is not as clear-cut, is if there is actual value received by the consumer from inclusion of the moisturizer. If market studies indicate that consumers purchase the product in preference to an identical product without a moisturizer, or if they subsequently use a moisturizing lotion after using a non-moisturizing soap, then equivalent use would entail including the separate moisturizing lotion. Including the moisturizing lotion would move the comparison beyond equivalent handwashing to equivalent hand washing and skin moisturizing.

In defining system boundaries, it is important to include every step that could affect the overall interpretation or ability of the analysis to address the issues for which it is being performed. Only in certain well-defined instances can life-cycle elements such as raw materials acquisition or waste management be excluded. In general, only when a step is exactly the same in process, materials, and quantity in all alternatives considered, can that step be excluded from the system. In addition, the framework for the comparison must be recognized as relative because the total system values exclude certain contributions. This rule is especially critical for LCAs used in public forums rather than for internal company decision making. For example, a company comparing alternative processes for producing one petrochemical product may not need to consider the use and disposal of the product if the final composition is identical. The company may also find that each process uses exactly the same materials in the same amounts per unit of product output. Therefore, the company may consider the materials it uses as having no impact in the study results. Another example is a filling operation for bottles. A company interested in using alternative materials for its bottles while maintaining the same size and shape may not need to include filling bottles. However, if the original bottles were compared to boxes of a different size and shape, the filling step would need to be included.

Applications of System Expansion

System expansion broadens the system boundaries and introduces a new functional unit to make the two systems being compared equal in scope. Take for example Product A which is produced by Process AB along with co-product B. Product A is to be compared to Product C which is the only product to be produced by Process C. Using system expansion, an alternative way to produce Product B is added to Process C. The comparison is now between Process AB and Process C plus Process D.

Another approach to applying system expansion is by subtracting the environmental burdens of an alternative way of producing Product B (using the same example as before) so that only Product A is compared to Product C. This approach is also referred to as the ***avoided burden*** approach since it is reasoned that the production of any alternative products is no longer needed and the resultant environmental burdens are avoided. The environmental burdens allocated to the product of interest are then calculated as the burdens from the process minus the burdens of an alternative co-product. For example, a process that also generates heat, such as a refrigerator, offsets some of the need for space heating which would be supplied by some other source. The emissions avoided through this reduced demand might include emissions such as carbon dioxide, sulfur dioxide, nitrogen oxide, carbon monoxide and hydrocarbons that are typically emitted from power generation facilities. This process can result in negative accounting of burdens if the subtracted releases do not occur in the main product system.



Resource constraints for the life-cycle inventory may be considerations in defining the system boundaries, but in no case should the scientific basis of the study be compromised. The level of detail required to perform a thorough inventory depends on the size of the system and the purpose of the study. In a large system encompassing several industries, certain details may not be significant contributors given the defined intent of the study. These details may be omitted without affecting the accuracy or application of the results. However, if the study has a very specific focus, such as a manufacturer comparing alternative processes or materials for inks used in packaging, it would be important to include chemicals used in very small amounts.

Additional areas to consider in setting boundaries include the manufacture of capital equipment, energy and emissions associated with personnel requirements, and precombustion impacts for fuel usage. These are discussed later.

After the boundaries of each system have been determined, a system flow diagram, as shown in Exhibit 2-2, can be developed to depict the system and direct efforts to gather data for the life cycle inventory.

Each system step should be represented individually in the diagram, including the production steps for ancillary inputs or outputs such as chemicals and packaging.

Determine the Ground Rules for Performing the Work

Prior to moving on to the inventory analysis phase it is important to define some of the logistical procedures for the project.

1. *Documenting Assumptions* - All assumptions or decisions made throughout the entire project must be reported along side the final results of the LCA project. If assumptions are omitted, the final results may be taken out of context or easily misinterpreted. As the LCA process advances from phase to phase, additional assumptions and limitations to the scope may be necessary to accomplish the project with the available resources.

2. *Quality Assurance Procedures* - Quality assurance procedures are important to ensure that the goal and purpose for performing the LCA will be met at the conclusion of the project. The level of quality assurance procedures employed for the project depends on the available time and resources and how the results will be used. If the results are to be used in a public forum, a formal review process is recommended. A formal review process may consist of internal and external review by LCA experts and/or a review by interested parties to better ensure their support of the final results. If the results are to be used for internal decision-making purposes only, then an internal reviewer who is familiar with LCA practices and is not associated with the LCA study may effectively meet the quality assurance goals. It is recommended that a formal statement from the reviewer(s) documenting their assessment of each phase of the LCA process be included with the final report for the project.

3. *Reporting Requirements* - Defining “up front” how the final results should be documented and exactly what should be included in the final report helps to ensure that the final product meets the appropriate expectations. When reporting the final results, or results of a particular LCA phase, it is important to thoroughly describe the methodology used in the analysis. The report should explicitly define the systems analyzed and the boundaries that were set. The basis for comparison among systems and all assumptions made in performing the work should be clearly explained. The presentation of results should be consistent with the purpose of the study. The results should not be oversimplified solely for the purposes of presentation.

Chapter 3
Life Cycle Inventory

What is a Life Cycle Inventory (LCI)?
A life cycle inventory is a process of quantifying energy and raw material requirements, atmospheric emissions, waterborne emissions, solid wastes, and other releases for the entire life cycle of a product, process, or activity.

Why Conduct an LCI?
In the life cycle inventory phase of an LCA, all relevant data is collected and organized. Without an LCI, no basis exists to evaluate comparative environmental impacts or potential improvements. The level of accuracy and detail of the data collected is reflected throughout the remainder of the LCA process.

Life cycle inventory analyses can be used in various ways. They can assist an organization in comparing products or processes and considering environmental factors in material selection. In addition, inventory analyses can be used in policy-making, by helping the government develop regulations regarding resource use and environmental emissions.

What Do the Results of the LCI Mean?
An inventory analysis produces a list containing the quantities of pollutants released to the environment and the amount of energy and material consumed. The results can be segregated by life cycle stage, media (air, water, and land), specific processes, or any combination thereof.

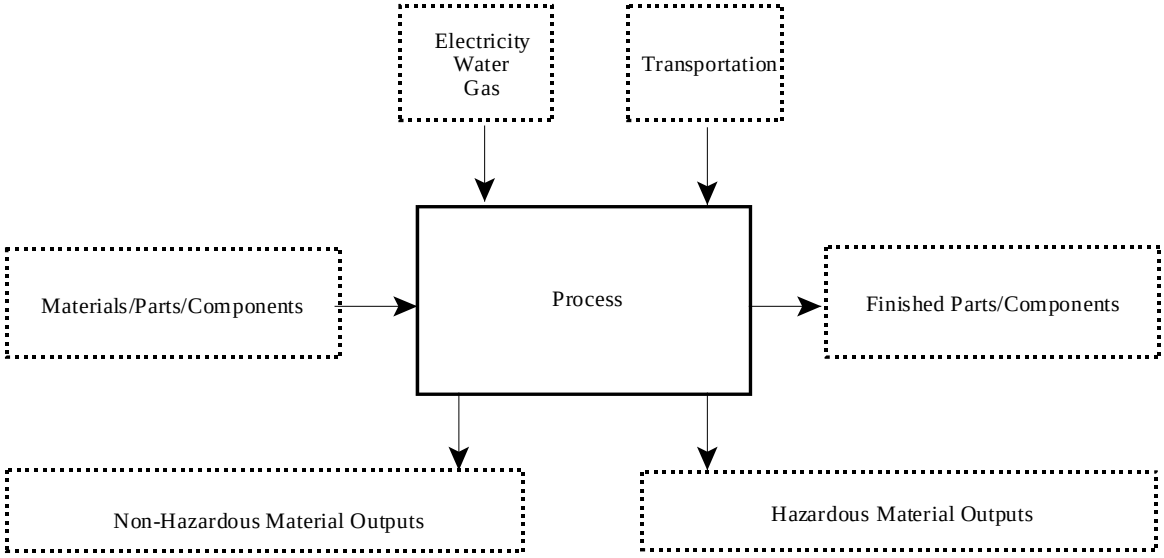
Key Steps of a Life Cycle Inventory
EPA's 1993 document, "Life-Cycle Assessment: Inventory Guidelines and Principles," and 1995 document, "Guidelines for Assessing the Quality of Life Cycle Inventory Analysis," provide the framework for performing an inventory analysis and assessing the quality of the data used and the results. The two documents define the following four steps of a life cycle inventory:

1. Develop a flow diagram of the processes being evaluated.
2. Develop a data collection plan.
3. Collect data.
4. Evaluate and report results.

Each step is summarized below.

<u>Step 1: Develop a Flow Diagram</u>
A flow diagram is a tool to map the inputs and outputs to a process or system. The "system" or "system boundary" varies for every LCA project. The goal definition and scoping phase establishes initial boundaries that define what is to be included in a particular LCA; these are used as the system boundary for the flow diagram. Unit processes inside of the system boundary link together to form a complete life cycle picture of the required inputs and outputs (material and energy) to the system. Exhibit 3-1 illustrates the components of a generic unit process within a flow diagram for a given system boundary.

Exhibit 3-1. Generic Unit Process



The more complex the flow diagram, the greater the accuracy and utility of the results. Unfortunately, increased complexity also means more time and resources must be devoted to this step, as well as the data collecting and analyzing steps.

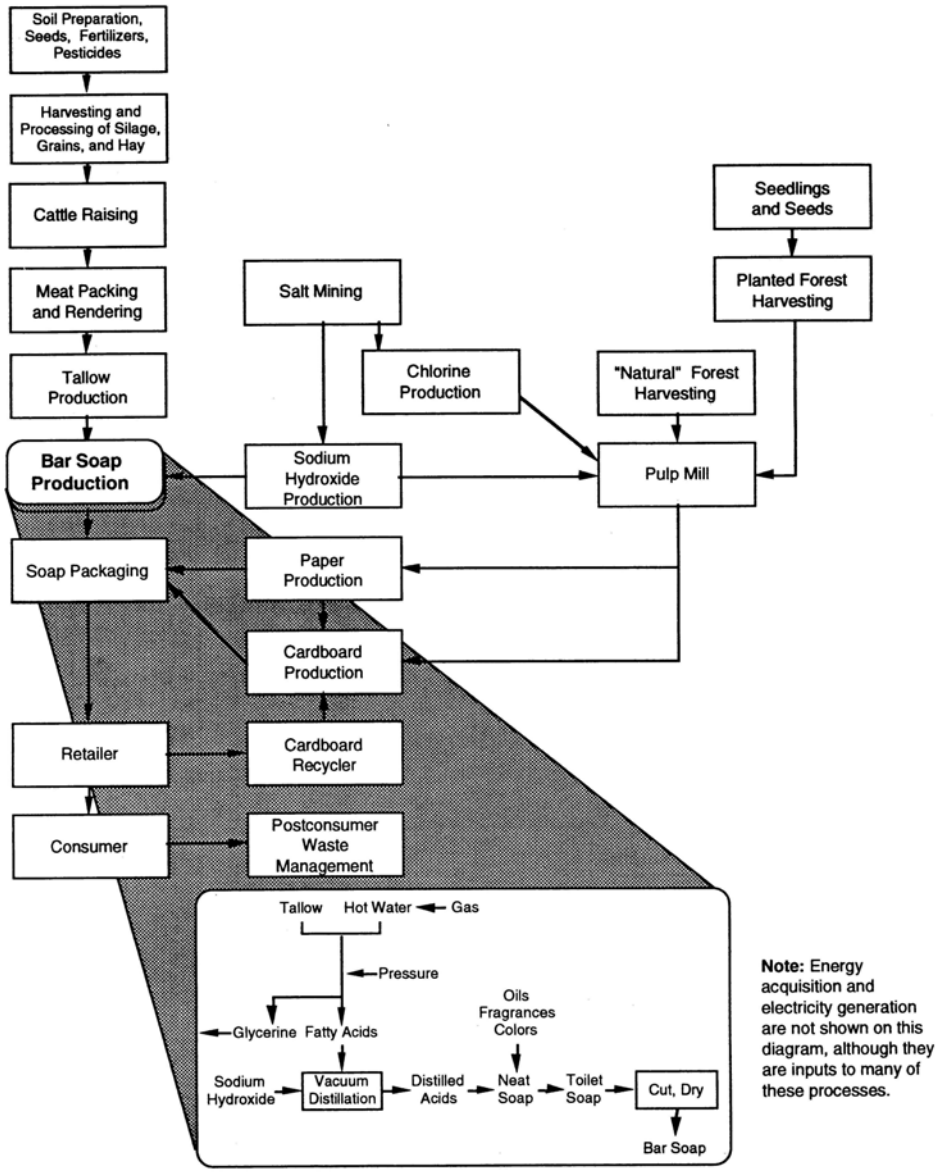
Flow diagrams are used to model all alternatives under consideration (e.g., both a baseline system and alternative systems). For a comparative study, it is important that both the baseline and alternatives use the same system boundary and are modeled to the same level of detail. If not, the accuracy of the results may be skewed.

For data-gathering purposes it is appropriate to view the system as a series of subsystems. A "subsystem" is defined as an individual step or process that is part of the defined production system. Some steps in the system may need to be grouped into a subsystem due to lack of specific data for the individual steps. For example, several steps may be required in the production of bar soap from tallow (see Exhibit 3-2). However, these steps may all occur within the same facility, which may not be able to or need to break data down for each individual step. The facility could however, provide data for all the steps together, so the subsystem boundary would be drawn around the group of soap production steps and not around each individual one.

Each subsystem requires inputs of materials and energy; requires transportation of product produced; and has outputs of products, co-products, atmospheric emissions, waterborne wastes, solid wastes, and possibly other releases. For each subsystem, the inventory analyst should describe materials and energy sources used and the types of environmental releases. The actual activities that occur should also be described. Data should be gathered for the amounts and kinds of material inputs and the types and quantities of energy inputs. The environmental releases to air, water, and land should be quantified by type of pollutant. Data collected for an inventory should always be associated with a quality measure. Although formal data quality indicators (DQIs) such as accuracy, precision, representativeness, and

completeness are strongly preferred, a description of how the data were generated can be useful in judging quality.

Exhibit 3-2. Detailed System Flow Diagram for Bar Soap



Co-products from the process should be identified and quantified. Co-products are process outputs that have value, i.e., those not treated as wastes. The value assigned to a co-product may be a market value (price) or may be imputed. In performing co-product allocation, some means must be found to objectively assign the resource use, energy consumption, and emissions among the co-products, because there is not a physical or chemical way to separate the activities that produce them. Generally, allocation should allow technically sound inventories to be prepared for products or materials using any particular output of a process independently and without overlap of the other outputs.

In the meat packing step of the bar soap example, several co-products could be identified: meat, tallow, bone meal, blood meal, and hides. Other examples of co-products are the trim scraps and off-spec materials from a molded plastic plate fabricator. If the trim scraps and off-spec materials are used or marketed to other manufacturers, they are considered as co-products. Industrial scrap is the common name given to such materials. If the trim is discarded into the solid waste stream to be landfilled, it should be included in the solid waste from the process. If the trim or off-spec materials are reused within the process, they are considered "home scrap," which is part of an internal recycling loop. These materials are not included in the inventory, because they do not cross the boundaries of the subsystem.

All transportation from one process location to another is included in the subsystem. Transportation is quantified in terms of distance and weight shipped, and identified by the mode of transport used.

Step 2: Develop an LCI Data Collection Plan

As part of the goal definition and scoping phase (discussed in Chapter 2), the required accuracy of data was determined. When selecting sources for data to complete the life cycle inventory, an LCI data collection plan ensures that the quality and accuracy of data meet the expectations of the decision-makers.

Key elements of a data collection plan include the following:

- Defining data quality goals
- Identifying data sources and types
- Identifying data quality indicators
- Developing a data collection worksheet and checklist.

Each element is described below.

Define Data Quality Goals - Data quality goals provide a framework for balancing available time and resources against the quality of the data required to make a decision regarding overall environmental or human health impact (EPA 1986). Data quality goals are closely linked to overall study goals and serve two primary purposes:

- Aid LCA practitioners in structuring an approach to data collection based on the data quality needed for the analysis.
- Serve as data quality performance criteria.

No pre-defined list of data quality goals exists for all LCA projects. The number and nature of data quality goals necessary depends on the level of accuracy required to inform the decision-makers involved in the process.

Examples of Data Quality Goals

The following is a sample list of hypothetical data quality goals:

- Site-specific data are required for raw materials and energy inputs, water consumption, air emissions, water effluents, and solid waste generation.
- Approximate data values are adequate for the energy data category.
- Air emission data should be representative of similar sites in the U.S.
- A minimum of 95 percent of the material and energy inputs should be accounted for in the LCI.

Identify Data Quality Indicators - Data quality indicators are benchmarks to which the collected data can be measured to determine if data quality requirements have been met. Similar to data quality goals, there is no pre-defined list of data quality indicators for all LCIs. The selection of data quality indicators depends upon which ones are most appropriate and applicable to the specific data sources being evaluated. Examples of data quality indicators are precision, completeness, representativeness, consistency, and reproducibility.

Identify Data Sources and Types - For each life cycle stage, unit process, or type of environmental release, specify the necessary data source and/or type required to provide sufficient accuracy and quality to meet the study's goals. Defining the required data sources and types prior to data collection helps to reduce costs and the time required to collect the data.

Examples of data sources include the following:

- Meter readings from equipment
- Equipment operating logs/journals
- Industry data reports, databases, or consultants
- Laboratory test results
- Government documents, reports, databases, and clearinghouses
- Other publicly available databases or clearinghouses
- Journals, papers, books, and patents
- Reference books
- Trade associations
- Related/previous life cycle inventory studies
- Equipment and process specifications
- Best engineering judgment.

Examples of data types include:

- Measured
- Modeled
- Sampled
- Non-site specific (i.e., surrogate data)
- Non-LCI data (i.e., data not intended for the purpose of use in an LCI)
- Vendor data.

The required level of aggregated data should also be specified, for example, whether data are representative of one process or several processes.

A number of sources should be used in collecting data. Whenever possible, it is best to get well-characterized industry data for production processes. Manufacturing processes often become more efficient or change over time, so it is important to seek current data. Inventory data can be facility-specific or more general and still remain current.

Several categories of data are often used in inventories. Starting with the most disaggregated, these are:

- Individual process- and facility-specific: data from a particular operation within a given facility that are not combined in any way.
- Composite: data from the same operation or activity combined across locations.

- Aggregated: data combining more than one process operation.
- Industry-average: data derived from a representative sample of locations and believed to statistically describe the typical operation across technologies.
- Generic: data whose representativeness may be unknown but which are qualitatively descriptive of a process or technology.

Complete and thorough inventories often require use of data considered proprietary by either the manufacturer of the product, upstream suppliers or vendors, or the LCA practitioner performing the study. Confidentiality issues are not relevant for life-cycle inventories conducted by companies using their own facility data for internal purposes. However, the use of proprietary data is a critical issue in inventories conducted for external use and whenever facility-specific data are obtained from external suppliers for internal studies. As a consequence, current studies often contain insufficient source and documentation data to permit technically sound external review. Lack of technically sound data adversely affects the credibility of both the life-cycle inventories and the method for performing them. An individual company's trade secrets and competitive technologies must be protected. When collecting data (and later when reporting the results), the protection of confidential business information should be weighed against the need for a full and detailed analysis or disclosure of information. Some form of selective confidentiality agreements for entities performing life-cycle inventories, as well as formalization of peer review procedures, is often necessary for inventories that will be used in a public forum. Thus, industry data may need to undergo intermediate confidential review prior to becoming an aggregated data source for a document that is to be publicly released.

The purpose, scope, and boundary of the inventory help the analyst determine the level or type of information that is required. For example, even when the analyst can obtain actual industry data, in what form and to what degree should the analyst show the data (e.g., the range of values observed, industry average, plant-specific data, and best available control techniques)? These questions or decisions can usually be answered if the purpose or scope has been well defined. Typically, most publicly available life-cycle documents present industry averages, while many internal industrial studies use plant-specific data. Recommended practice for external life-cycle inventory studies includes the provision of a measure of data variability in addition to averages. Frequently, the measure of variability will be a statistical parameter, such as a standard deviation.

Examples of private industry data sources include independent or internal reports, periodic measurements, accounting or engineering reports or data sets, specific measurements, and machine specifications. One particular issue of interest in considering industrial sources, whether or not a formal public data set is established, is the influence of industry and related technical associations to enhance the accuracy, representativeness, and currentness of the collected data. Such associations may be willing, without providing specific data, to confirm that certain data (about which their members are knowledgeable) are realistic.

Government documents and data bases provide data on broad categories of processes and are publicly available. Most government documents are published on a periodic basis, e.g., annually, biennially, or every four years. However, the data published within them tend to be at least several years old. Furthermore, the data found in these documents may be less specific and less accurate than industry data for specific facilities or groups of facilities. However, depending on the purpose of the study and the specific data objectives, these limitations may not be critical. All studies should note the age of the data used. Some useful government documents include:

- U.S. Department of Commerce, Census of Manufacturers
- U.S. Bureau of Mines, Census of Mineral Industries

- U.S. Department of Energy, Monthly Energy Review
- U.S. Environmental Protection Agency, Toxics Release Inventory (TRI) Database.

Government data bases include both non-bibliographic types where the data items themselves are contained in the data base and bibliographic types that consist of references where data may be found.

Technical books, reports, conference papers, and articles published in technical journals can also provide information and data on processes in the system. Most of these are publicly available. Data presented in these sources are often older, and they can be either too specific or not specific enough. Many of these documents give theoretical data rather than real data for processes. Such data may not be representative of actual processes or may deal with new technologies not commercially tested. In using the technical data sources in the following list, the analyst should consider the date, specificity, and relevancy of the data:

- *Encyclopedia of Chemical Technology*, Kirk-Othmer
- Periodical technical journals such as *Journal of the Water Environment Federation*
- Proceedings from technical conferences
- Textbooks on various applied sciences.

Surveys designed to capture information on a representative sample of end users can provide current information on the parameters of product or service use. Surveys typically center around a question:

- How long or how many times is a product or service used before it is discarded (e.g., the number of years a television set has been in use and is expected to be in use)?
- What other materials and what quantities of these materials are used in conjunction with product use or maintenance (e.g., moisturizing lotion used after hand washing)?
- How frequent is the need for product repair or maintenance (e.g., how often is an appliance repaired over its lifetime, and who does the repair)?
- What other uses does the product have beyond its original purpose?
- What does the end user do with the product when he or she is through with it?

Frequently, the end user will not be able to supply specific information on inputs and outputs. However, the end user can provide data on user practices from which inputs and outputs can be derived. Generally, the end user can be the source of related information from which the energy, materials, and pollutant release inventory can be derived. (An exception would be an institutional or commercial end user who may have some information on energy consumption or water effluents.) Market research firms can often provide qualitative and quantitative usage and customer preference data without the analyst having to perform independent market surveys.

Recycling provides an example of some of the strengths and limitations encountered in gathering data. For some products, economic-driven recycling has been practiced for many years, and an infrastructure and markets for these materials already exist. Data are typically available for these products, including recycling rates, the consumers of the reclaimed materials, and the resource requirements and environmental releases form the recycling activities (collection and reprocessing). Data for materials currently at low recycling rates with newly forming recycling infrastructures are more difficult to obtain. In either case, often the best source for data on resource requirements and environmental releases is the processors themselves. For data on recycling rates and recycled material, consumers and processors may be helpful, but trade associations as well as the consumers of the recycled materials can also provide data. For materials that are recycled at low rates, data will be more difficult to find.

Two other areas for data gathering relate to the system as a whole and to comparisons between and among systems. It is necessary to obtain data on the weights of each component in the product evaluated, either by obtaining product specifications from the manufacturer or by weighing each component. These data are then used to combine the individual components in the overall system analysis. Equivalent use ratios for the products compared can be developed by surveying retailers and consumers, or by reviewing consumer or trade association periodicals.

Develop a Data Collection Spreadsheet – The next step is to develop a life cycle inventory spreadsheet that covers most of the decision areas in the performance of an inventory (see Appendix A which shows a sample inventory spreadsheet). A spreadsheet can be prepared to guide data collection and validation and to enable construction of a database to store collected data electronically. The following eight general decision areas should be addressed in the inventory spreadsheet:

- Purpose of the inventory
- System boundaries
- Geographic scope
- Types of data used
- Data collection procedures
- Data quality measures
- Computational spreadsheet construction
- Presentation of results.

The spreadsheet is a valuable tool for ensuring completeness, accuracy, and consistency. It is especially important for large projects when several people collect data from multiple sources. The spreadsheet should be tailored to meet the needs of a specific LCI.

The overall system flow diagram, derived in the previous step, is important in constructing the computational spreadsheets because it numerically defines the relationships of the individual subsystems to each other in the production of the final product. These numerical relationships become the source of "proportionality factors," which are quantitative relationships that reflect the relative contributions of the subsystems to the total system. For example, data for the production of a particular ingredient X of bar soap are developed for the production of 1,000 tons of X. To produce 1,000 tons of bar soap, 250 tons of X are needed, accounting for losses and inefficiencies. Thus, to find the contributions of X to the total system, the data for 1,000 tons of X are multiplied by 0.250.

The spreadsheet can be used to make other computations beyond weighting the contributions of various subsystems. It can be used to translate energy fuel value to a standard energy unit, such as million British thermal unit (Btu) or gigajoule (GJ). Precombustion or resource acquisition energy can be computed by applying a standard factor to a unit quantity of fuel to account for energy used to obtain and transport the fuel. Energy sources, as well as types of wastes, can be categorized. Credits or charges for incineration can be derived. Fuel-related wastes should also be calculated based on the fuels used throughout the system. The spreadsheet should also incorporate waste management options, such as recycling, composting, and landfilling.

It is important that each subsystem be incorporated in the spreadsheet with its related components and that each be linked together in such as way that inadvertent omissions and double-counting do not occur. The spreadsheet can be organized in several different ways to accomplish this purpose. These can include allocating certain fields or areas in the spreadsheet to certain types of calculations or using one type of spreadsheet software to actually link separate spreadsheets in hierarchical fashion. It is imperative,

however, once a system of organization is used, that it be employed consistently. Haphazard organization of data sets and calculations generally leads to faulty inventory results.

Many decisions must be made in every life-cycle inventory analysis. Every inventory consists of a mix of factual data and assumptions. Assumptions allow the analyst to evaluate a system condition when factual data either cannot be obtained within the context of the study or do not exist. Each piece of information (e.g., the weight of paperboard used to package the soap, type of vehicle and distance for shipping the tallow, losses incurred when rendering tallow, or emissions resulting from the animals at the feedlot), fall into one or the other category and each plays a role in developing the overall system analysis. Because assumptions can substantially affect study results, a series of "what if" calculations or sensitivity analyses are often performed on the results to examine the effect of making changes in the system. A sensitivity analysis will temporarily modify one or more parameters and affect the calculation of the results. Observing the change in the results will help determine how important the assumptions are with respect to the results. The computational spreadsheet is also used to perform these sensitivity analysis calculations.

Decision Points within Life Cycle Inventory

During the 2003 InLCA/LCM conference in Seattle, Washington, a session was organized with the specific intent of initiating open discussion on inventory methodology and determining if there was support behind the idea of developing international procedural guidelines for inventory, going beyond the ISO 14040 and 14041 guidance. The general consensus of the group in Seattle was that there is a need and desire for more detailed guidance, especially around the following list of suggested key decision points within life cycle inventory:

- Co-product allocation
- Recycling allocation
- Exclusion of small amounts
- Exclusion of spills and losses
- Age-appropriateness of data
- Surrogate and estimated data
- Inventory for impact assessment
- Matching the goal to the method
- Collecting primary data
- Report format
- Iterative procedure for data collection
- Choosing boundaries
- Capital equipment/infrastructure exclusions
- Time and location meta data.

Sometimes it is helpful to think ahead about how the results will be presented. This can direct some decisions on how the spreadsheet output is specified. The analyst must remember the defined purpose for performing the analysis and tailor the data output to those expressed needs. For example, the analyst might ask: Is the purpose of the life-cycle inventory to evaluate the overall system results? Or is it expected that detailed subsystem information will be analyzed in relation to the total? Will the study be used in a public forum? If so, how? How much detail is required? Answers to questions such as these will help determine the complexity and the degree of generalization to build into the spreadsheet, as well as the appropriate presentation of results.

Step 3: Collect Data

Data collection efforts involve a combination of research, site-visits and direct contact with experts, which generates large quantities of data. As an alternative, it may be more cost effective to buy a commercially available LCA software package (see Appendix B). Prior to purchasing an LCA software package the decision-makers or LCA practitioner should insure that it will provide the level of data analysis required.

A second method to reduce data collection time and resources is to obtain non-site specific inventory data. Several organizations have developed databases specifically for LCA that contain some of the basic data commonly needed in constructing a life cycle inventory. Some of the databases are sold in conjunction with LCI data collection software; others are stand-alone resources (see Appendix B). Many companies with proprietary software also offer consulting services for LCA design. The use of commercial software risks losing transparency in the data. Often there is no record of assumptions or computational methods that were used. This may not be appropriate if the results are to be used in the public domain. Revisiting the goal statement is needed in order to determine if such data are appropriate.

All industrial processes have multiple input streams and many generate multiple output streams. Usually only one of the outputs is of interest for the life cycle assessment study being conducted, so the analyst needs to determine how much of the energy and material requirements and the environmental releases associated with the process should be attributed, or allocated, to the production of each co-product. For example, steam turbine systems may sell both electricity and low-pressure steam as useful products. When co-products are present, the practitioner must determine how much of the burdens associated with operating and supplying the multi-output process should be allocated to each co-product. The practitioner must also decide how to allocate environmental burdens across co-products when one is a waste stream that can be sold for other uses.

The guidance provided by the International Standards Organization (ISO) recognizes the variety of approaches that can be used to treat the allocation issue and, therefore, requires a step-wise approach (see text box on ISO 14041). The standard calls for practitioners to avoid allocation if possible; and secondly, to model approaches which reflect the physical relationships between the process outputs and its inputs. Proper application of the ISO guidelines on allocation requires a good understanding of the physical relationships between co-products in a process.

Although avoiding allocation is favored by the ISO standard, it is not always possible to expand systems in all cases. And, as alluded to earlier, allocation cannot be totally avoided even in a system expansion approach. Therefore, other options must be used.

Although mass has most often been used as a basis for allocation, allocation by volume is done in a similar way. Methods based on market value usually include expected economic gain based on gross sales. However, none of these methods offers a general solution. Allocation may seem impractical in cases where one product far outweighs another. Although market value in most cases reflects the use of energy and therefore many of the associated burdens, allocation on this basis covers only one aspect of the system. Also, market value is highly variable over time, sometimes up to 50 percent in a short time period. Allocation on an equal basis (50/50) or on an “all or none” basis (100 percent to one product) can be considered to be a highly arbitrary choice.

Environmental burdens related to the alternative systems must still be modeled using an appropriate method where co-products are generated. A lot has been published in the open literature on the subject in an effort to better understand the consequences of allocation choices.

ISO 14041: 6.5.3 Allocation Procedure

On the basis of the principles mentioned above, the following stepwise procedure shall be applied.

Step 1: Wherever possible, allocation should be avoided by:

1) Dividing the unit process to be allocated into two or more subprocesses and collecting the input and output data related to these subprocesses.
2) Expanding the product system to include the additional functions related to the co-products, taking into account the requirements of (function, functional unit, and reference flow).

Step 2: Where allocation cannot be avoided, the inputs and outputs of the system should be partitioned between its different products or functions in a way which reflects the underlying physical relationships between them, i.e., they shall reflect the way in which the inputs and outputs are changed by quantitative changes in the products or functions delivered by the system. The resulting allocation will not necessarily be in proportion to any simple measurement such as mass or molar flows of coproducts.

Step 3: Where physical relationship alone cannot be established or used as the basis for allocation, the inputs should be allocated between the products and functions in a way which reflects other relationships between them. For example, input and output data might be allocated between coproducts in proportion to the economic value of the products.

The flow diagram(s) developed in Step 1 provides the road map for data to be collected. Step 2 specifies the required data sources, types, quality, accuracy, and collection methods. Step 3 consists of finding and filling in the flow diagram and worksheets with numerical data. This may not be a simple task. Some data may be difficult or impossible to obtain, and the available data may be difficult to convert to the functional unit needed. Therefore, the system boundaries or data quality goals of the study may have to be refined based on data availability. This iterative process is common for most LCAs.

Inputs in the Product Life-Cycle Inventory Analysis
The decision on which raw/intermediate material requirements to include in a life-cycle inventory is complex, but several options are available:

- Incorporate all requirements, no matter how minor, on the assumption that it is not possible *a priori* to decide to exclude anything.
- Within the defined scope of the study, exclude inputs of less than a predetermined and clearly stated threshold.
- Within the defined scope of the study, exclude inputs determined likely to be negligible, relative to the intended use of the information, on the basis of a sensitivity analysis.
- Within the defined scope, consistently exclude certain classes or types of inputs, such as capital equipment replacement.

The advantage of the first option is that no assumptions are made in defining and drawing the system boundary. The analyst does not have to explain or defend what has been included or excluded. The disadvantage is that application of this approach could be an endless exercise. The number of inputs could be very large and could include some systems only distantly related to the product system of

interest. Besides the computational complexity, interpretation of the results with respect to the single desired product, package, or activity could be difficult.

The second option, if implemented with full explanation of what the threshold is and why it was selected, would have the advantages of consistency and lower cost and time investments. Two suboptions can be identified, depending on the nature of the threshold. One suboption is to specify a percentage contribution below which the material will be excluded, for example, one percent of the input to a given subsystem or to the entire system. The one percent rule historically has been useful in limiting the extent of the analysis in inventories where the environmental consequences of quantitatively minor materials are not considered. The disadvantage of the one percent rule is that the possible presence of an environmentally damaging activity associated with these materials could be overlooked. Also, when used with mixed percentages (e.g., percent of system energy, percent of subsystem input), the result may be confusing or inconsistent. The scoping analysis should provide a rationale for choosing to apply such a rule.

The second suboption is to set a threshold based on the number of steps that the raw/intermediate material is removed from the main process sequence. Consider the bar soap example discussed earlier. Caustic manufacture from brine electrolysis is part of the main process sequence and would clearly be included. Sodium carbonate is an input material for the production of caustic is therefore a secondary input. Applying a "one-step back" decision rule would include the steps associated with sodium carbonate production. Ammonium chloride is an input material for the production of sodium carbonate using the Solvay process. Relative to caustic, ammonium chloride is a tertiary input and would be excluded if a "one-step back" decision rule were applied. As in the first option, the "one-step back" decision rule has the advantages of clarity and consistent application. For some inputs that are analyzable in exact mathematical terms, the "one-step back" rule may be justifiable. If the inputs to a given process bear a fixed relationship to the next-tier process, one step is all that may be necessary to obtain a sufficiently accurate value (Boustead and Hancock 1979).

Consider the example of a refinery. Most of the refinery's output is sold for production of petroleum-based materials. However, a small portion, say eight percent, is used to run the refinery. This portion, termed the parasitic fraction, is mathematically related to the refinery output as:

$$M(1+f)$$

where:
M is the output product and
f is the parasitic fraction (0.08)

For a life-cycle inventory on a petroleum-based plastic, the primary output of the refinery clearly would be included within the system boundary. Suppose the data quality indicators showed that the data were accurate to $\pm$ 5 percent. Because of the first-tier use of the material represents an eight percent difference, a "one-step back" rule would include the refinery material (fuel) output used to run the refinery. However, to produce the material (fuel) to run the refinery requires a further fraction of the output two steps back for the plastic raw material. This is calculated as:

$$M(1+f+f^2).$$

Thus, the incremental contribution of the second step back is 0.6 percent, which is less than the data accuracy. That is, there is no significant difference in the system data after the first step. Disadvantages of this approach include the lack of simple geometric relationships for many inputs and the increased effort to analyze more tiers as data quality increases.

The third option, drawing boundaries based on sensitivity analysis, adds the advantage of being systematic rather than arbitrary in assigning the threshold. The disadvantages of a sensitivity analysis-based approach are that the analyst needs to be very clear in describing how the analysis was used and, unless a large existing database is available to supply preliminary values that can be used in the sensitivity analysis, the required analysis effort may not be limited by a very large amount. A more in-depth discussion of sensitivity analysis is provided later in this chapter.

The final option, excluding certain classes or types of input, also has been found through experience to apply to many systems. For example, in the bar soap inventory, a decision may be made to exclude the equipment used to cut the bars of soap. The justification is that the allocation of inputs and outputs from the manufacture of the machine is minuscule when the millions of bars of soap produced by the machine are considered. The advantage of this option is that many complex subsystems can often be excluded. The disadvantages are the same as those for the first option, namely, that a highly significant activity may be eliminated. Capital equipment is the most commonly excluded input type. The analyst should perform a preliminary analysis to characterize the basic activities in each class or type of input to ensure that a significant contribution is not left out.

Energy

Energy represents a combination of energy requirements for the subsystem. Three categories of energy are quantifiable: process, transportation, and energy of material resources (inherent energy).

Process energy is the energy required to operate and run the subsystem process(es), including such items as reactors, heat exchangers, stirrers, pumps, blowers, and boilers. Transportation energy is the energy required to power various modes of transportation such as trucks, rail carriers, barges, ocean vessels, and pipelines. Conveyors, forklifts, and other equipment that could be considered with transportation or process are labeled according to their role in the subsystem. For example, power supplied to a conveyor used to carry material from one point in the subsystem would be labeled process energy. On the other hand, the power supplied to a conveyor used to transport material from one subsystem to a different subsystem would be considered transportation energy.

Two alternatives exist for incorporating energy inputs in a subsystem module. One is to report the actual energy forms of the inputs, e.g., kilowatt-hours (kWh) of electricity or cubic feet of natural gas. The other is to include the specific quantities of fuels used to generate the produced energy forms in the module.

The advantage of the first approach is that the specific energy mix is available for each subsystem. For example, a company may want to evaluate the desirability of installing a natural gas-fired boiler to produce steam compared to using its electrically heated boiler powered by a combination of purchased and on-site generated electricity. A specific fuel mix could be applied to compute the energy and fuel resource use. The second approach, incorporating specific fuel quantities, allows a subsystem comparison of primary energy fuels. For example, “x” kilowatt-hours of electricity would be specified as “y” cubic feet of natural gas and “z” pounds of uranium.

Within each subsystem, the energy input data should be given as specific quantities of fuel and then converted into energy equivalents according to the conversion factors discussed in the following two sections. For example, the energy requirements attributed to a polyethylene resin plant may be specified as 500 pounds of ethylene for feedstock, 500 cubic feet of natural gas, 50 kilowatt-hours of electricity to run the process equipment, and 50 gallons of diesel fuel to transport the resin to consumers. In this case, the 50 kilowatt-hours would be converted to 180 megajoules.

Combustion and Precombustion Values

To report all energy usage associated with the subsystem of concern, the analyst may need to consider energy data beyond the primary process associated with combustion of the fuel. The energy used in fuel combustion is only part of the total energy associated with the use of fuel. The amount of energy expended to acquire the fuel also may be significant in comparison to other energy expenditures. Energy to acquire fuel raw materials (e.g., mining coal or drilling for oil), process these raw materials into usable fuels, and transport them is termed by various practitioners as "precombustion energy" or "energy of fuel acquisition." Precombustion energy is defined as the total amount of energy necessary to deliver a usable fuel to the consumer of the fuel.

Including precombustion energy is analogous to extending the system boundaries for fuels to raw material inputs. For example, suppose the combustion of fuel oil in an industrial boiler results in the release of about 150,000 Btu per gallon. However, crude oil drilling and production, refining, and transporting the fuel oil require an additional 20,000 Btu per gallon. This additional energy is the precombustion energy. Thus, the total energy expended (precombustion energy plus combustion energy) when a gallon of fuel oil is consumed would be 170,000 Btu. Generally, a complete inventory will include precombustion energy contributions because they represent the true energy demand of the system. Inclusion or exclusion of this contribution should be clearly stated.

Energy Sources

Energy is obtained from a variety of sources, including coal, nuclear power, hydropower, natural gas, petroleum, wind, solar energy, solid waste, and wood biomass. Fuels are interchangeable, to a high degree, based on their energy content. For example, an electric utility decides which fuel or other energy source to use based on the cost per energy unit. Utilities can and do use multiple forms of energy sources, making possible an economic decision based on the energy cost per kilowatt-hour of electricity generated. Manufacturing companies also choose among energy sources on the same basis. However, reasons other than cost, such as scarcity or emissions to the environment, also affect the energy source decision. For example, during periods of petroleum shortages, finding products that use predominantly non-petroleum energy sources may be desirable. For that reason, the inventory should characterize energy requirements according to basic sources of energy. Thus, it would consider not only electricity, but also the basic sources (such as coal, nuclear power, hydropower, natural gas, and petroleum) that produce the electricity.

Electricity: Considerations associated with electricity include the source of fuel used to generate the electricity and the efficiency of the generating system. Power utilities typically use coal, nuclear power, hydropower, natural gas, or oil to generate electricity. Non-utility generation sources can include wind power, waste-to-energy, and geothermal energy. Accurately determining electrical energy use and associated emissions raises several complications, such as relating the actual electricity use of a single user to the actual fuel used.

Although a given company pays its bills to a particular utility, the company is not simply purchasing power from the nearest plant. Once electricity is generated and fed into power lines, it is indistinguishable from electricity from any other source. Individual generating stations owned by a given utility may use different fuels. The electricity generated by these stations is "mixed" in the transmission lines of that utility. The utility is interconnected with neighboring utilities (also using various types of fuel), to form regional grids, which then interconnect to form a national grid.

Computational models currently used to perform life-cycle inventories of electricity in the United States are based on the fuel mix in regional grids or on a national average. In many cases where an industry is scattered throughout the United States, the fuel mix for the national grid (available from the U.S.

Department of Energy) can be used, making calculations easier without sacrificing accuracy. Data for 2004 are shown in Table 3-1.

Table 3-1. U.S. National Electrical Grid Fuel Mix for 2004

Fuel	Gigawatt-hours (GWh)	Percent
Coal	1,976,333	50
Nuclear	788,556	19.9
Hydro	261,545	6.6
Natural Gas	714,600	18.1
Oil	117,591	3
Biomass	60,042	1.5
Other*	34,741	0.9
Total	3,953,408	100

Source: Edison Electric Institute, http://www.eei.org/industry_issues/industry_overview_and_statistics/industry_statistics/index.htm#fuelmix

* Includes geothermal, solar and wind power.

One exception to the national grid assumption is the electroprocess industries which use vast amounts of electricity. Aluminum smelting is the primary example. It and the other electroprocessing industries are not distributed nationally, so a national electricity grid does not give a reasonable approximation of their electricity use. They are usually located in regions of inexpensive electric power. Some plants have purchased their own electric utilities. In recognition of this fact, specific regional grids or data from on-site facilities are commonly used for life-cycle inventories of the electroprocessing industries.

The energy efficiency of the electricity-generating and delivery system must also be considered. The theoretical conversion from the common energy unit of kilowatt-hour to common fuel units (megajoules) is 3.61 MJ per kWh. Ideally, the analyst would compute a specific efficiency based on the electrical generation fuel mix actually used. This value is derived by comparing the actual fuels consumed by the electricity-generating industry in the appropriate regional or national grid to the actual kilowatt-hours of electricity delivered for useful work. The value includes boiler inefficiencies and transmission line losses. However, a conversion of 11.3 MJ per kWh may be used in most cases to reflect the actual use of fuel to deliver electricity to the consumer from the national grid.

Nuclear Power: Nuclear power substitutes for fossil fuels in the generation of electricity. There is no measurement of nuclear power directly equivalent to the joules of fossil fuel, so nuclear power typically is measured as its fossil fuel equivalency. The precombustion energy of nuclear power is usually added to the fuel equivalency value. The precombustion energy includes that for mining and processing, as well as the increased energy requirement for power plant shielding.

Hydropower: Most researchers traditionally have counted hydropower at its theoretical energy equivalence of 3.61 MJ per kWh, with no precombustion impacts included. No precombustion factors are used for hydropower because water does not have an inherent energy value from which line transmission losses, etc., can be subtracted. The contribution of the capital equipment is small in light of the amount of hydroelectric energy generated using the equipment. Disruption to ecosystems typically has not been considered in the inventory. However, quantitative inventory measures that may be suitable for characterizing related issues, such as habitat loss due to land use conversion, potentially could be included. Factors addressing area damage, recovery time, and ecosystem function are under consideration for inclusion in the impact analysis.

Water

Water volume requirements should be included in a life-cycle inventory analysis. In some locations, water is plentiful. Along the coasts, seawater is usable for cooling or other manufacturing purposes. However, in other places water is in short supply and must be allocated for specific uses. Some areas have abundant water in some years and limited supplies in other years. Some industrial applications reuse water with little new or makeup water required. In other applications, however, tremendous amounts of new water inputs are required.

How should water be incorporated in an inventory? The goal of the inventory is to measure, per unit of product, the gallons of water required that represent water unavailable for beneficial uses (such as navigation, aquatic habitat, and drinking water). Water withdrawn from a stream, used in a process, treated, and replaced in essentially the same quality and in the same location should not be included in the water-use inventory data. Ideally, water withdrawn from groundwater and subsequently discharged to a surface water body should be included, because the groundwater is not replaced to maintain its beneficial purposes. Data to make this distinction may be difficult to obtain in a generic study where site-specific information is not available.

In practice, the water quantity to be estimated is net consumptive usage. Consumptive usage as a life-cycle inventory input is the fraction of total water withdrawal from surface or groundwater sources that either is incorporated into the product, co-products (if any), or wastes, or is evaporated. As in the general case of renewable versus nonrenewable resources, valuation of the degree to which the water is or is not replenishable is best left to the impact assessment.

Outputs of the Product Life-Cycle Inventory Analysis

A traditional inventory qualifies three categories of environmental releases or emissions: atmospheric emissions, waterborne waste, and solid waste. Products and co-products also are quantified. Each of these areas is discussed in more detail in the following sections. Most inventories consider environmental releases to be actual discharges (after control devices) of pollutants or other materials from a process or operation under evaluation. Inventory practice historically has included only regulated emissions for each process because of data availability limitations. It is recommended that analysts collect and report all available data in the detailed tabulation of subsystem outputs. In a study not intended for product comparisons, all of these pollutants should be included in the summary presentations.

A comparative study offers two options. The first is to include in the summary presentation only data available for alternatives under consideration. The advantage of this option is that it gives a comparable presentation of the loadings from all the alternatives. The disadvantage is that potentially consequential information, which is available only for some of the alternatives, may not be used. The second option is to report all data whether uniformly available or not. In using this option, the analyst should caution the user not to draw any conclusions about relative effects for pollutants where comparable data are not available. “Comparable” is used here to mean the same pollutant. For example, in a summary of data on a bleached paper versus plastic packaging alternatives, data on dioxin emissions may be available only for the paper product. The second option is recommended for internal studies and for external studies where proper context can be provided.

Atmospheric Emissions

Atmospheric emissions are reported in units of weight and include all substance classified as pollutants per unit weight of product output. These emissions generally have included only those substances required by regulatory agencies to be monitored but should be expanded where feasible. The amounts reported represent actual discharges into the atmosphere after passing through existing emission control devices. Some emissions, such as fugitive emissions from valves or storage areas, may not pass through control devices before release to the environment. Atmospheric emissions from the production and

combustion of fuel for process or transportation energy (fuel-related emissions), as well as the process emissions, are included in the life-cycle inventory.

Typical atmospheric emissions are particulates, nitrogen oxides, volatile organic compounds (VOCs), sulfur oxides, carbon monoxide, aldehydes, ammonia, and lead. This list is neither all-inclusive nor is it a standard listing of which emissions should be included in the life-cycle inventory. Recommended practice is to obtain and report emissions data in the most speciated form possible. Some air emissions, such as particulates and VOCs, are composites of multiple materials whose specific makeup can vary from process to process. All emissions for which there are obtainable data should be included in the inventory. Therefore, the specific emissions reported for any system, subsystem, or process will vary depending on the range of regulated and nonregulated chemicals.

Certain materials, such as carbon dioxide and water vapor losses due to evaporation (neither of which is a regulated atmospheric emission for most processes), have not been included in most inventory studies in the past. Regulations for carbon dioxide are changing as the debate surrounding the greenhouse effect and global climate change continues and the models used for its prediction are modified. Inclusion of these emerging emissions of concern is recommended.

Waterborne Wastes

Waterborne wastes are reported in units of weight and include all substances generally regarded as pollutants per unit of product output. These wastes typically have included only those items required by regulatory agencies, but the list should be expanded as data are available. The effluent values include those amounts still present in the waste stream after wastewater treatment, and represent actual discharges into receiving waters. For some releases, such as spills directly into receiving waters, treatment devices do not play a role in what is reported. For some materials, such as brine water extracted with crude oil and reinjected into the formation, current U.S. regulations do not define such materials as waterborne wastes, although they may be considered in solid waste regulations under the Resource Conservation and Recovery Act (RCRA). Other liquid wastes may also be deep well injected and should be included. In general, the broader definition of emissions in a life-cycle inventory, in contrast to regulations, would favor inclusion of such streams. It can be argued, from a systems analysis standpoint, that materials such as brine should count as releases from the subsystem because they cross the subsystem boundary. If wastes and spills that occur are discharged to the ocean or some other body of water, these values are always reported as wastes.

As with atmospheric wastes, waterborne wastes from the production and combustion of fuels (fuel-related emissions), as well as process emissions, are included in the life-cycle inventory.

Some of the most commonly reported waterborne wastes are biological oxygen demand (BOD), chemical oxygen demand (COD), suspended solids, dissolved solids, oil and grease, sulfides, iron, chromium, tin, metal ions, cyanide, fluorides, phenol, phosphates, and ammonia. Again, this listing of emissions is not meant to be a standard for what should be included in an inventory. Some waterborne wastes, such as BOD and COD, consist of multiple materials whose composition can vary from process to process. Actual waterborne wastes will vary for each system depending on the range of regulated and nonregulated chemicals.

Solid Waste

Solid waste includes all solid material that is disposed from all sources within the system. U.S. regulations include certain liquids and gases in the definition as well. Solid wastes typically are reported by weight. A distinction is made in data summaries between industrial solid wastes and post-consumer solid wastes, as they are generally disposed of in different ways and, in some cases, at different facilities. *Industrial solid waste* refers to the solid waste generated during the production of a product and its

packaging and is typically divided into two categories: process solid waste and fuel-related solid waste. *Post-consumer solid waste* refers to the product/packaging once it has met its intended use and is discarded into the municipal solid waste stream.

Process solid waste is the waste generated in the actual process, such as trim or waste materials that are not recycled, as well as sludges and solids from emissions control devices. *Fuel-related waste* is solid waste produced from the production and combustion of fuels for transportation and operating the process. Fuel combustion residues, mineral extraction wastes, and solids from utility air control devices are examples of fuel-related wastes.

In the United States, mine tailings and overburden generally are not regulated as solid waste. However, the regulations require overburden to be replaced in the general area from which it was removed. Furthermore, environmental consequences associated with the removal of mine tailings and overburden should be included. The regulations do not require industrial solid waste to be handled off site. Therefore, researchers try to report all solid waste from industrial processes destined for disposal, whether off site or local. Historically, no distinctions have been made between hazardous and nonhazardous solid waste, nor have individual wastes been specifically characterized. However, in view of the potentially different environmental effects, analysts will find it useful to account for these wastes separately, especially if an impact assessment is to be conducted.

Products

The products are defined by the subsystem and/or system under evaluation. In other words, each subsystem will have a resulting product, with respect to the entire system. This subsystem product may be considered either a raw material or intermediate material with respect to another system, or the finished product of the system.

Again using the bar soap example, when examining the meat packaging subsystem, meat, tallow, hides, and blood would all be considered product outputs. However, because only tallow is used in the bar soap system, tallow is considered the only product from that subsystem. All other material outputs (not released as wastes or emissions) are considered co-products. If the life-cycle assessment were performed on a product such as a leather purse, hides would be considered the product from the meat packaging subsystem, and all other outputs would be considered co-products.

Although for bar soap the tallow is considered the product from the meat packaging subsystem, it is simultaneously an intermediate material within the bar soap system. Thus, from these examples one can see that classifying a material as a product in a life-cycle study depends, in part, on the extent of the system being examined, i.e., the position from which the material is viewed or the analyst's point of view.

Transportation

The life-cycle inventory includes the energy requirements and emissions generated by the transportation requirements among subsystems for both distribution and disposal of wastes. Transportation data are reported in miles or kilometers shipped. This distance is then converted into units of ton-miles or tonne-kilometers, which is an expression involving the weight of the shipment and the distance shipped. Materials typically are transported by rail, truck, barge, pipeline, and ocean transport. The efficiency of each mode of transport is used to convert the units of ton-miles into fuel units (e.g., gallons of diesel fuel). The fuel units are then converted to energy units, and calculations are made to determine the emissions generated from the combustion of the fuels.

Exhibit 3-2 shows that transportation is evaluated for the product leaving each subsystem. This method of evaluating transportation avoids any inadvertent double-counting of transportation energy or emissions. Transportation is reported only for the product of interest from a subsystem and not for any co-products

of the subsystem, because the destination of the co-products is not an issue. The raw materials for the bar soap production system, for example, include salt from salt mining and trees from natural forest harvesting. Applying the template to these two subsystems shows that the transport of salt from the mining operation and the transport of trees from the logging operation must be included in the data collected for these subsystems.

The salt is transported to chlorine/sodium hydroxide plants, and the trees are transported to pulp mills. Applying the template to these subsystems shows that the transport of chlorine and sodium hydroxide from those plants to pulp mills is part of the chlorine production and sodium hydroxide subsystems. Likewise, the transport of pulp to paper mills is part of the pulp mill subsystem. The transport of raw materials, salt, and trees into the subsystems (chlorine production, sodium hydroxide production, and pulp mills) now being evaluated has already been accounted for in the evaluation of the salt mining and natural forest harvesting subsystems. Applying the template throughout the bar soap system shows the evaluation of transportation ending with the post-consumer waste management subsystem, where wastes may be transported to a final disposal site.

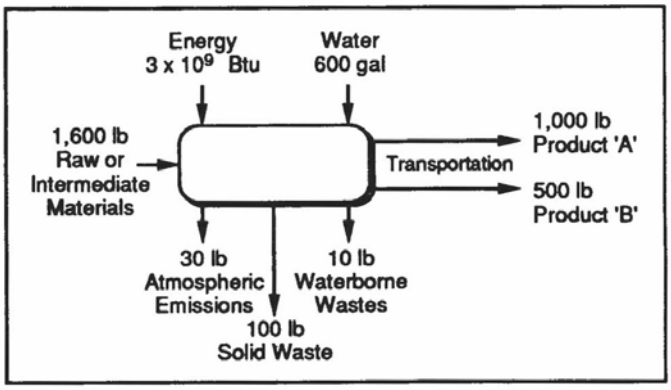
Backhauling may be a situation where there is some overlap between the transportation associated with product distribution and the transportation associated with recycling of the product or a different product after consumer use. A backhaul has been described as occurring when a truck or rail carrier has a profitable load in one direction and is willing to accept a reduced rate for a move in the return direction. Backhaul opportunities occur when the demand for freight transportation in one area is relatively low and carriers have a financial incentive to move their vehicles, loaded or empty, to a place where the demand for freight transportation is higher. Due to the lowered transportation rates, recycled materials, especially paper and aluminum, are often transported by backhauling. Thus, a carrier may take a load of new paper from a mill to customers in a metropolitan area and pick up loads of scrap paper in the same area to bring them back to the mill. In this scenario, backhauling may reduce the energy and emissions associated with distribution of a product (made from new paper) by assigning energy and emissions associated with an empty return trip to the recycled scrap paper.

Co-Product Allocation

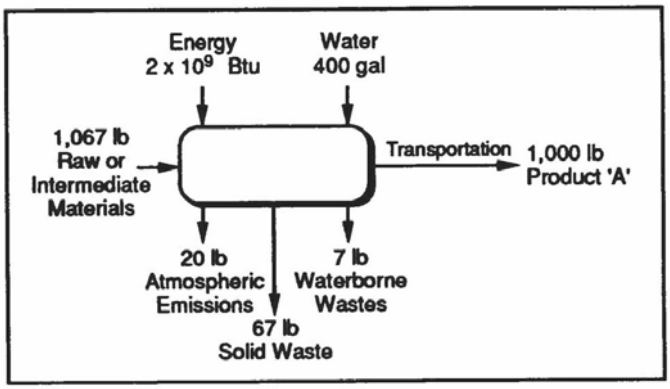
Most industrial processes are physical and/or chemical processes. The fundamentals of life-cycle inventory are based on modeling a system in such a way that calculated values reasonably represent actual (measurable) occurrences. Some processes generate multiple output streams in addition to waste streams. In attributional LCAs, only certain of these output streams are of interest with respect to the primary product being evaluated (see the text box in Chapter 2 on the distinction between attributional and consequential LCAs). The term co-product is used to define all output streams other than the primary product that are not waste streams and that are not used as raw materials elsewhere in the system examined in the inventory. Co-products are of interest only to the point where they no longer affect the primary product, i.e. the product that is part of the life cycle system being studied. Subsequent refining of co-products is beyond the scope of the analysis, as is transport of co-products to facilities for further refining. A basis for co-product allocation needs to be selected with careful attention paid to the specific items calculated. Each industrial system must be handled on a case-by-case basis since no allocation basis exists that is always applicable.

Exhibit 3-3. Allocating Resources and Environmental Burdens on a Mass Basis for a Product and Co-Product (Source: EPA 1993)

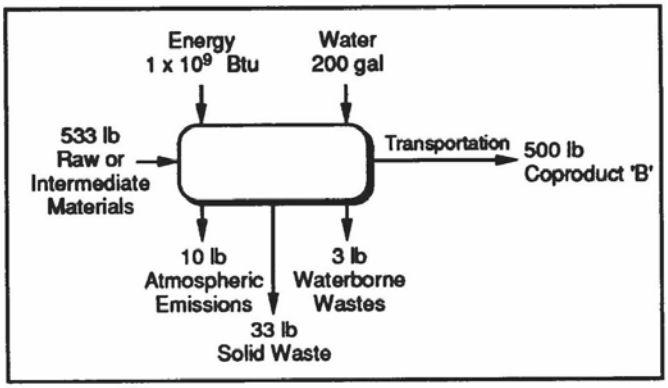
Co-Product Allocation for Product "A" and Product "B"



Co-Product Allocation for Product "A"



Co-Product Allocation for Product "B"



In effect, the boundary for the analysis is drawn between the primary product and co-products, with all materials and environmental loadings attributed to co-products being outside the scope of the analysis. For example, the production of fatty acids from tallow for soap manufacture generates glycerine, a secondary stream that is collected and sold. Glycerine, therefore, is considered a co-product, and its processing and use would be outside the scope of the bar soap analysis.

Basis for Co-Product Allocation

The first step is to investigate any complex process in detail and attempt to identify unit subprocesses that produce the product of interest. If sufficient detail can be found, no co-product allocation will be necessary. The series of subprocesses that produce the product can simply be summed. Many metal manufacturing plants illustrate this approach. In steel product manufacture, all products are made by melting the raw materials, producing iron, and then producing raw steel. These steps are followed by a series of finishing operations that are unique to each product line. It is generally possible to identify the particular subprocesses in the finishing sequence of each product and to collect sufficient data to carry out the life-cycle inventory without co-product allocation. In many cases, a careful analysis of unit systems will avoid the need to make co-product allocations. Still, in some cases, such as a single chemical reaction vessel that produces several different products, there is no analytical method for cleanly separating the subprocesses. In this example, co-product allocation is necessary.

The analyst needs to determine the specific resource and environmental categories requiring study. For a given product, different co-product allocations may be made for different resource and environmental categories. To find the raw materials needed to produce a product, a simple mass balance will help track the various input materials into the output materials. For instance, if a certain amount of wood is needed to produce several paper products, and the analysis concerns only one of the products, then a mass allocation scheme, as demonstrated in Exhibit 3-3, will be used to determine the amount of wood required for the target product.

If a process produces several different chemical products, care must be taken in the analysis. It will be necessary to write balanced chemical equations and trace the chemical stoichiometry from the raw materials into the products. A simple mass allocation method frequently gives reasonable results, but not always. In calculating energy, heat of reaction may be the appropriate basis for allocating energy to the various co-products.

If the various co-product chemicals are quite different in nature, some other allocation method may be needed. For example, an electrolytic cell can produce hydrogen and oxygen from water. Each water molecule requires two electrons to produce two hydrogen atoms and one oxygen atom. On a macroscopic basis, electricity that produces one mole (or two grams) of hydrogen only produces one-half mole (or 16 grams) of oxygen. Thus, the input electrical energy would be allocated between the hydrogen and oxygen co-products on a molar basis. That is, two-thirds of the energy would be allocated to the hydrogen and one-third to the oxygen, resulting in an energy per unit mass for hydrogen that is 16 times that of oxygen. However, conservation of mass is used to determine the material requirements. Each mole of water (18 grams) contains two grams of hydrogen atoms and 16 grams of oxygen atoms, and the dissociation of the water results in two grams of hydrogen and 16 grams of oxygen. Thus, a mass allocation would be appropriate for raw material calculations in this example.

For environmental emissions from a multiple-product process, allocation to different co-products may not be possible. For example, in a brine cell that produces sodium, chlorine, and hydrogen as co-products, it may be tempting to associate any emissions containing chlorine with the chlorine co-product alone. However, because the sodium and hydrogen are also produced by the same cell and cannot be produced from this cell without also producing chlorine, all emissions should be considered as joint wastes. The question arises as to how to allocate chlorine emissions (as well as other emissions) to all three products.

It has been suggested that the selling price of the co-products could be used as a basis for this allocation. Because the selling prices of the various co-products can vary greatly with time and with independent competitive markets for each co-product, a market-based approach would have to accommodate such variations, by using an average value ranged over several years, or similar method.

Further, it has been suggested that the notion of 'demand product' could be used to avoid allocation. The idea is to recognize when a process was created with the intent of producing a single main product of interest, i.e. the one in demand. By-products and wastes that are created as a result of manufacturing this demand product are considered to be incidental, including those that may have found a market over the years. Therefore, all of the environmental burdens are allocated to the demand product.

One final issue is the distinction between marginal wastes and co-products. In some cases it is not clear whether a material is a waste or a co-product. A hypothetical example might be a valuable mineral that occurs as 0.1 percent of an ore. For each pound of mineral product, 999 pounds of unneeded material is produced. This discarded material might find use as a road aggregate. As such, it has value and displaces other commercial aggregates and appears to be a co-product along with the valuable mineral. However, its value is so low that in some cases it may simply be dumped back on the ground because of limited markets. Whether this material is considered a waste or a co-product may have a significant effect on the results of a product life-cycle inventory. It does not seem reasonable to use a simple mass allocation scheme here. It is more reasonable to assume that all of the energy and other resources and emissions associated with this process are incurred because of the desire for the valuable product mineral. However, there are some cases where the "waste" has marginal, but greater value than the example used here.

It becomes difficult in some instances to determine precisely which of the co-product allocation methodologies discussed above is most "correct." One important role of an inventory is to provide information upon which impact assessment and improvement analysis can be based. In cases where there is no clear methodological solution, the inventory should include reasonable alternative calculations or apply sensitivity analysis to determine the effect of allocation on the final results. It remains at some later time to make the judgments as to which of several reasonable alternatives is the correct one. In any event, it should be made clear what assumptions were made and what procedures were used.

Industrial Scrap

One co-product stream of particular interest is *industrial scrap*. This term is used to specifically identify process wastes of value (trim scraps and off-spec materials) that are produced as an integral part of a manufacturing process. Further, the wastes have been collected and used as input materials for additional manufacturing processes. The last criterion is that these scrap materials have never been used as originally intended when manufactured. For example, a common polyurethane foam product is seat cushions for automobiles. The trim from cutting the cushions is never incorporated into seat cushions. Likewise, off-spec seat cushions sold as industrial scrap are never used as seat cushions, but are used as input material for another process.

A careful distinction must be made between industrial scrap and post-consumer waste for proper allocation in the inventory. If the industrial scrap is to be collected and used as a material input to a production system or process, it is credited in the life-cycle inventory as a co-product at the point where it was produced. Unfortunately, systems that use material more efficiently, i.e., that produce lesser amounts of salable co-products, assume a higher percentage of the upstream energy and releases using the criterion.

When the consumption of a co-product falls within the boundaries of the analysis, it must no longer be considered as a co-product, but as a primary product carrying with it all the energy requirements and

environmental releases involved with producing it, beginning with raw materials acquisition. For example, a study of carpet underlayment made from polyurethane scrap would include the manufacturing steps for producing the polyurethane scrap. Its production must be handled, as is any other subsystem of a life-cycle inventory. Industrial scrap does not displace virgin raw materials, because the consumption of the industrial scrap redefines the system to include the virgin materials for its production (isocyanates and polyalcohols in the case of polyurethane foam). Tallow is another example of a material that would be defined as an industrial scrap/co-product. Historically, the thinking has been that once a material shifts from the waste category to being a utilized material, or a co-product, then it should bear some of the burden (energy, raw/intermediate material input, and environmental releases) for its own production.

Data Time Period

The time period that data represents should be long enough to smooth out any deviations or variations in the normal operations of a facility. These variations might include plant shutdowns for routine maintenance, startup activities, and fluctuation in levels of production. Often data are available for a fiscal year of production, which is usually a sufficient time period to cover such variations.

Specific Data versus Composite Data

When the purpose of the inventory is to find ways to improve internal operations, it is best to use data specific to the system that is being examined. These types of data are usually the most accurate and also the most helpful in analyzing potential improvements to the environmental profile of a system. However, private data typically are guarded by a confidentiality agreement, and must be protected from public use by some means. Composite, industry-average data are preferable when the inventory results are to be used for broad application across the industry, particularly in studies performed for public use. Although composite data may be less specific to a particular company, they are generally more representative of an industry as a whole. Such composite data can also be made publicly available, are more widely usable, and are more general in nature. Composite data can be generated from facility-specific data in a systematic fashion and validated using a peer review process. Variability, representativeness, and other data quality indicators can still be specified for composite data.

Geographic Specificity

Natural resource and environmental consequences occur at specific sites, but there are broader implications. It is important to define the scope of interest (regional vs. national vs. international) in an inventory. A local community may be more interested in direct consequences to itself than in global concerns.

In general, most inventories done domestically relate only to that country. However, if the analysis considers imported oil, the oilfield brines generated in the Middle East should be considered. It has been suggested that the results of life-cycle inventories indicate which energy requirements and environmental releases (of the total environmental profile of a product) are local. However, due to the fact that industries are not evenly distributed, this segmenting can be done only after an acceptable level of accuracy is agreed on. The United States, Canada, Western Europe, and Japan have the most accurate and most readily available information on resource use and environmental releases. Global aspects should be considered when performing a study on a system that includes foreign countries or products, or when the different geographic locations are a key difference among products or processes being compared. As a compromise, when no specific geographical data exist, practices that occur in other countries typically are assumed to be the same as for their domestic counterparts. These assumptions and the inherent limitations associated with their application should be documented within the inventory report. In view of the more stringent environmental regulations in developed countries, this assumption, while necessary, often is not correct. Energy use and other consequences associated with importing materials should also be included.

Technology Mixes/Energy Types

For inventory studies of processes using various technology mixes, market share distribution of the technologies may be necessary to accurately portray conditions for the industry as a whole. The same is true of energy sources. Most inventories can be based on data involving the fuel mix in the national grid for electricity. There are exceptions, such as the aluminum electroprocessing industry previously discussed. Variations of this kind must be taken into account when applying the life-cycle inventory methodology. Also, as previously mentioned, conditions can differ greatly across international borders.

Data Categories

Environmental emission databases usually cover only those items or pollutants required by regulatory agencies to be reported. For example, as previously mentioned, the question of whether to report only regulated emissions or all emissions is complicated by the difficulty in obtaining data for unregulated emissions. In some cases, emissions that are suspected health hazards may not be required to be reported by a regulatory agency because the process of adding them to the list is slow. A specific example of an unregulated emission is carbon dioxide, which is a greenhouse gas suspected as a primary agent in global warming. There is no current requirement for reporting carbon dioxide emissions, and it is difficult to obtain measured data on the amounts released from various processes. Thus, results for emissions reported in a life-cycle inventory may not be viewed as comprehensive, but they can cover a wide range of pollutants. As a rule, it is recommended that data be obtained on as broad a range as possible. Calculated or qualitative information, although less desirable and less consistent with the quantitative nature of an inventory, may still be useful.

Routine/Fugitive/Accidental Releases

Whenever possible, routine, fugitive, and accidental emissions data should be considered in developing data for a subsystem. If data on fugitive and accidental emissions are not available, and quantitative estimates cannot be obtained, this deficiency should be noted in the report on the inventory results. Often estimates can be made for accidental emissions based on historical data pertaining to frequency and concentrations of accidental emissions experienced at a facility.

When deciding whether to include accidents, they should be divided into two categories based on frequency. For the low-frequency and high-magnitude events, e.g., major oil spills, tools other than life-cycle inventory may be appropriate. Unusual circumstances are difficult to associate with a particular product or activity. More frequent, lower magnitude events should be included, with perhaps some justification for keeping their contribution separate from routine operations.

Special Case Boundary Issues

In all studies, boundary conditions limiting the scope must be established. The areas of capital equipment, personnel issues, and improper waste disposal typically are not included in inventory studies, because they have been shown to have little effect on the results. Earlier studies did consider them in the analysis; later studies have verified their minimal contribution to the total system profile. Thus, exclusion of contributions from capital equipment manufacture, for example, is not excluded *a priori*. The decision to include or not to include them should be clearly noted by the analyst.

Capital Equipment - The energy and resources that are required to construct buildings and to build process equipment should be considered. However, for most systems, capital expenditures are allocated to a large number of products manufactured during the lifetime of the equipment. Therefore, the resource use and environmental effluents produced are usually small when attributed to the system of interest. The energy and emissions involved with capital equipment can be excluded when the manufacture of the item itself accounts for a minor fraction of the total product output over the life of the equipment.

Personnel Issues - Inventory studies focus on the comprehensive results of product consumption, including manufacturing. At any given site, there are personnel-related effluents from the manufacturing process as well as wastes from lunchroom trash, energy use, air conditioning emissions, water pollution from sanitary facilities, and others. In addition, inputs and outputs during transportation of personnel from their residence to the workplace can be significant, depending on the purpose and scope of the inventory. In many situations, the personnel consequences are very small and would probably occur whether or not the product was manufactured. Therefore, exclusion from the inventory may be justified. The analyst should be explicit about including or excluding this category. For these issues, the goals of the study should be considered. If the study is comparative, and one option is significantly different in personnel or capital equipment requirements, then at least a screening-level evaluation should be performed to support an inclusion or exclusion decision.

Improper Waste Disposal - For most studies it is assumed that wastes are properly disposed into the municipal solid waste stream or wastewater treatment system. Illegal dumping, littering, and other improper waste disposal methods typically are not considered in life-cycle inventories as a means of solid waste disposal. Where improper disposal is known to occur and where environmental effects are known or suspected, a case may be made to include these activities.

Economic Input/Output Approach to Life Cycle Inventory

Economic Input/Output offers an alternative way to create life cycle inventory. The input/output model divides an entire economy into distinct sectors and represents them in table, or matrix, form so that each sector is represented by one row and one column. The matrix represents sales from one sector to another. Most nations have created input/output tables although few are as detailed as the U.S. model which provides 480 sectors. The economic input-output model is linear so that the effects of purchasing $1,000 from one sector will be ten times greater than the effects of purchasing $100 from that sector.

In order to create life cycle inventory, the economic output for each sector is first calculated, then the environmental outputs are calculated by multiplying the economic output at each stage by the environmental impact per dollar of output. The advantage of the economic input/output approach is that it quickly covers an entire economy, including all the material and energy inputs, thereby simplifying the inventory creation process. Its main disadvantage is that the data are created at high aggregate levels for an entire industry, such as steel mills, rather than particular products, such as the type of steel used to make automobiles.

“Hybrid” models which combine the economic input/output model with process models have also been proposed in order to utilize the advantages offered by both approaches.
(Hendrickson *et al* 2006)

Step 4: Evaluate and Document the LCI Results

When writing a report to present the final results of the life-cycle inventory, it is important to thoroughly describe the methodology used in the analysis. The report should explicitly define the systems analyzed and the boundaries that were set. All assumptions made in performing the inventory should be clearly explained. The basis for comparison among systems should be given, and any equivalent usage ratios that were used should be explained.

Life-cycle inventory studies generate a great deal of information, often of a disparate nature. The analyst needs to select a presentation format and content that are consistent with the purpose of the study and that do not arbitrarily simplify the information solely for the sake of presenting it. In thinking about presentation of the results, it is useful to identify the various perspectives embodied in life-cycle inventory information. These dimensions include, but may not be limited to, the following:

- Overall product system
- Relative contribution of stages to the overall system
- Relative contribution of product components to the overall system
- Data categories within and across stages, e.g., resource use, energy consumption, and environmental releases
- Data parameter groups within a category, e.g., air emissions, waterborne wastes, and solid waste types
- Data parameters within a group, e.g., sulfur oxides, carbon dioxide, chlorine, etc.
- Geographic regionalization if relevant to the study, e.g., national versus global
- Temporal changes.

The life-cycle analyst must select among these dimensions and develop a presentation format that increases comprehension of the findings without oversimplifying them. Two main types of format for presenting results are tabular and graphical.

Sometimes it is useful to report total energy results while also breaking out the contributions to the total from process energy and energy of material resources. Solid wastes can be separated into postconsumer solid waste and industrial solid waste. Individual atmospheric and water pollutants should be reported separately. Atmospheric emissions, waterborne wastes, and industrial solid wastes can also be categorized by process emissions/wastes and fuel-related emissions/wastes. Such itemized presentations can assist in identifying and subsequently controlling certain energy consumption and environmental releases.

The results from the inventory can be presented most comprehensibly in tabular form. The choice of how the tables should be created varies, based on the purpose and scope of the study. If the inventory has been performed to help decide which type of package to use for a particular product, showing the overall system results will be the most useful way to present the data. On the other hand, when an analysis is performed to determine how a package can be changed to reduce its releases to the environment, it is important to present not only the overall results, but also the contributions made by each component of the packaging system. For example, in analyzing a liquid delivery system that uses plastic bottles, it may be necessary to show how the bottle, the cap, the label, the corrugated shipping box, and the stretch wrap around the boxes all contribute to the total results. The user can thus concentrate improvement efforts on the components that make a substantial contribution when evaluating proposed changes.

Graphical presentation of information helps to augment tabular data and can aid in interpretation. Both bar charts (either individual bars or stacked bars) and pie charts are valuable in helping the reader visualize and assimilate the information from the perspective of “gaining ownership or participation in life-cycle assessment” (Werner 1991). However, the analyst should not aggregate or sum dissimilar data when creating or simplifying a graph.

For internal industrial use by product manufacturers, pie charts showing a breakout by raw materials, process, and use/disposal have been found useful in identifying waste reduction opportunities.

For external studies, the data must be presented in a format that meets one fundamental criterion - clarity. Ensuring clarity requires that the analyst ask and answer questions about what each graph is intended to convey. It may be necessary to present a larger number of graphs and incorporate fewer data in each one. Each reader should understand the desired response after viewing the information.

Now that the data has been collected and organized into one format or another, the accuracy of the results must be verified. The accuracy must be sufficient to support the purposes for performing the LCA as defined in the goal and scope (see Chapter 2 for a discussion on goal definition).

Steps 1 and 2 of Chapter 5, Life Cycle Interpretation, describe how to efficiently assess the accuracy of the LCI results. As illustrated in Exhibit 1-2, Phases of an LCA, in Chapter 1, LCA is an iterative process. Determining the sensitivity of the LCI data collection efforts in regard to data accuracy prior to conducting the saves time and resources. Otherwise, the life cycle impact assessment effort may have to be repeated if it is later determined that the accuracy of the data is insufficient to draw conclusions.

When documenting the results of the life cycle inventory, it is important to thoroughly describe the methodology used in the analysis, define the systems analyzed and the boundaries that were set, and all assumptions made in performing the inventory analysis. Use of the worksheet (see Step 2) supports a clear process for documenting this information.

The outcome of the inventory analysis is a list containing the quantities of pollutants released to the environment and the amount of energy and materials consumed. The information can be organized by life cycle stage, media (air, water, and land), specific process, or any combination thereof that is consistent with the ground rules defined in Chapter 2, Goal Definition and Scoping, for reporting requirements.

Chapter 4
Life Cycle Impact Assessment

What is a Life Cycle Impact Assessment (LCIA)?

The Life Cycle Impact Assessment (LCIA) phase of an LCA is the evaluation of potential human health and environmental impacts of the environmental resources and releases identified during the LCI. Impact assessment should address ecological and human health effects; it should also address resource depletion. A life cycle impact assessment attempts to establish a linkage between the product or process and its potential environmental impacts. For example, what are the impacts of 9,000 tons of carbon dioxide or 5,000 tons of methane emissions released into the atmosphere? Which is worse? What are their potential impacts on smog? On global warming?

LCA versus Risk Assessment

An important distinction exists between life cycle impact assessment (LCIA) and other types of impact analysis. LCIA does not necessarily attempt to quantify any specific actual impacts associated with a product, process, or activity. Instead, it seeks to establish a linkage between a system and potential impacts. The models used within LCIA are often derived and simplified versions of more sophisticated models within each of the various impact categories. These simplified models are suitable for relative comparisons of the potential to cause human or environmental damage, but are not indicators of absolute risk or actual damage to human health or the environment. For example, risk assessments are often very narrowly focused on a single chemical at a very specific location. In the case of a traditional risk assessment, it is possible to conduct very detailed modeling of the predicted impacts of the chemical on the population exposed and even to predict the probability of the population being impacted by the emission. In the case of LCIA, hundreds of chemical emissions (and resource stressors) which are occurring at various locations are evaluated for their potential impacts in multiple impact categories. The sheer number of stressors being evaluated, the variety of locations, and the diversity of impact categories makes it impossible to conduct the assessment at the same level of rigor as a traditional risk assessment. Instead, LCIA models are based on the accepted models within each of the impact categories using assumptions and default values as necessary. The resulting models that are used within LCIA are suitable for relative comparisons, but not sufficient for absolute predictions of risk.

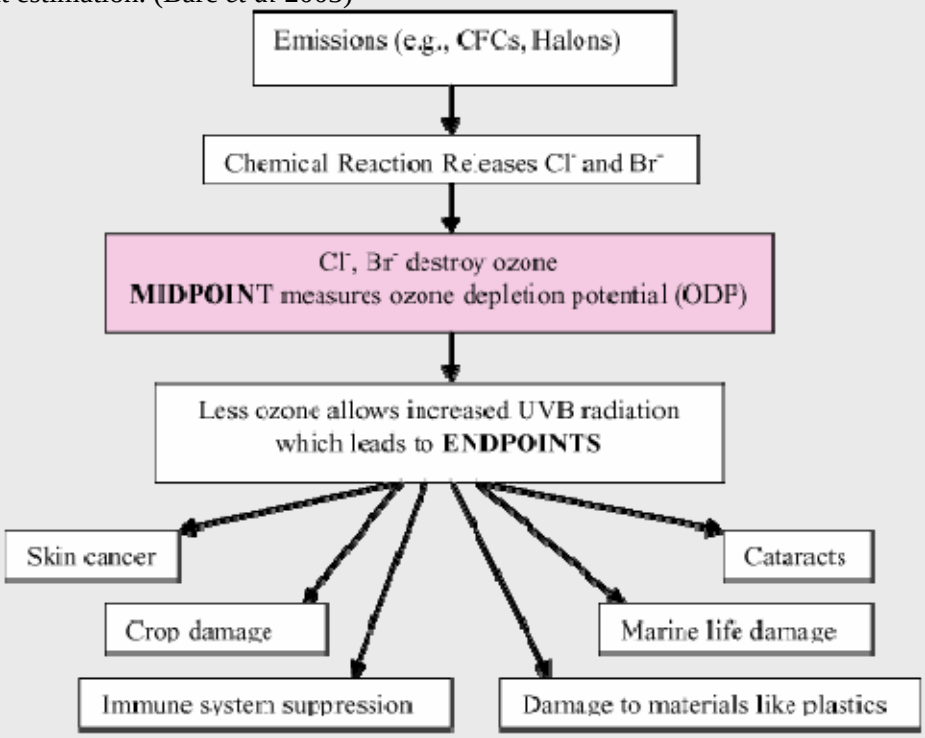
The key concept in this component is that of stressors. A stressor is a set of conditions that may lead to an impact. For example, if a product or process is emitting greenhouse gases, the increase of greenhouse gases in the atmosphere *may* contribute to global warming. Processes that result in the discharge of excess nutrients into bodies of water *may* lead to eutrophication. An LCIA provides a systematic procedure for classifying and characterizing these types of environmental effects.

Why Conduct an LCIA?

Although much can be learned about a process by considering the life cycle inventory data, an LCIA provides a more meaningful basis to make comparisons. For example, although we know that 9,000 tons of carbon dioxide and 5,000 tons of methane released into the atmosphere are both harmful, an LCIA can determine which could have a greater potential impact. Using science-based characterization factors, an LCIA can calculate the impacts each environmental release has on problems such as smog or global warming.

Midpoint versus Endpoint Modeling

Midpoint impact assessment models reflect the relative potency of the stressors at a common midpoint within the cause-effect chain. Analysis at a midpoint minimizes the amount of forecasting and effect modeling incorporated into the LCIA, thereby reducing the complexity of the modeling and often simplifying communication. Midpoint modeling can minimize assumptions and value choices, reflect a higher level of societal consensus, and be more comprehensive than model coverage for endpoint estimation. (Bare *et al* 2003)



What Do the Results of an LCIA Mean?

The results of an LCIA show the relative differences in potential environmental impacts for each option. For example, an LCIA could determine which product/process causes more global warming potential.

Key Steps of a Life Cycle Impact Assessment

The following steps comprise a life cycle impact assessment.

1. *Selection and Definition of Impact Categories* - identifying relevant environmental impact categories (e.g., global warming, acidification, terrestrial toxicity).
2. *Classification* - assigning LCI results to the impact categories (e.g., classifying carbon dioxide emissions to global warming).
3. *Characterization* - modeling LCI impacts within impact categories using science-based conversion factors (e.g., modeling the potential impact of carbon dioxide and methane on global warming).
4. *Normalization* - expressing potential impacts in ways that can be compared (e.g. comparing the global warming impact of carbon dioxide and methane for the two options).

5. *Grouping* - sorting or ranking the indicators (e.g. sorting the indicators by location: local, regional, and global).
6. *Weighting* - emphasizing the most important potential impacts.
7. *Evaluating and Reporting LCIA Results* - gaining a better understanding of the reliability of the LCIA results.

ISO developed a standard for conducting an impact assessment entitled ISO 14042, *Life Cycle Impact Assessment* (ISO 1998), which states that the first three steps – impact category selection, classification, and characterization – are mandatory steps for an LCIA. Except for data evaluation (Step 7), the other steps are optional depending on the goal and scope of the study.

Step 1: Select and Define Impact Categories

The first step in an LCIA is to select the impact categories that will be considered as part of the overall LCA. This step should be completed as part of the initial goal and scope definition phase to guide the LCI data collection process and requires reconsideration following the data collection phase. The items identified in the LCI have potential human health and environmental impacts. For example, an environmental release identified in the LCI may harm human health by causing cancer or sterility, or affect workplace safety. Likewise, a release identified in the LCI could also affect the environment by causing acid rain, global warming, or endangering species of animals.

For an LCIA, impacts are defined as the consequences that could be caused by the input and output streams of a system on human health, plants, and animals, or the future availability of natural resources. Typically, LCIAs focus on the potential impacts to three main categories: human health, ecological health, and resource depletion. Exhibit 4-1 shows some of the more commonly used impact categories.

Step 2: Classification

The purpose of classification is to organize and possibly combine the LCI results into impact categories. For LCI items that contribute to only one impact category, the procedure is a straightforward assignment. For example, carbon dioxide emissions can be classified into the global warming category.
For LCI items that contribute to two or more different impact categories, a rule must be established for classification. There are two ways of assigning LCI results to multiple impact categories (ISO 1998):

- Partition a representative portion of the LCI results to the impact categories to which they contribute. This is typically allowed in cases when the effects are dependent on each other.
- Assign all LCI results to all impact categories to which they contribute. This is typically allowed when the effects are independent of each other.

For example, since nitrogen dioxide could potentially affect both ground level ozone formation and acidification (at the same time), the entire quantity of nitrogen dioxide would be assigned to both impact categories (e.g., 100 percent to ground level ozone and 100 percent to acidification). This procedure must be clearly documented.

Exhibit 4-1. Commonly Used Life Cycle Impact Categories

Impact Category	Scale	Examples of LCI Data (i.e. classification)	Common Possible Characterization Factor	Description of Characterization Factor
Global Warming	Global	Carbon Dioxide (CO_2) Nitrogen Dioxide (NO_2) Methane (CH_4) Chlorofluorocarbons (CFCs) Hydrochlorofluorocarbons (HCFCs) Methyl Bromide (CH_3Br)	Global Warming Potential	Converts LCI data to carbon dioxide (CO_2) equivalents Note: global warming potentials can be 50, 100, or 500 year potentials.
Stratospheric Ozone Depletion	Global	Chlorofluorocarbons (CFCs) Hydrochlorofluorocarbons (HCFCs) Halons Methyl Bromide (CH_3Br)	Ozone Depleting Potential	Converts LCI data to trichlorofluoromethane (CFC-11) equivalents.
Acidification	Regional Local	Sulfur Oxides (SOx) Nitrogen Oxides (NOx) Hydrochloric Acid (HCL) Hydroflouric Acid (HF) Ammonia (NH_4)	Acidification Potential	Converts LCI data to hydrogen (H+) ion equivalents.
Eutrophication	Local	Phosphate (PO_4) Nitrogen Oxide (NO) Nitrogen Dioxide (NO_2) Nitrates Ammonia (NH_4)	Eutrophication Potential	Converts LCI data to phosphate (PO_4) equivalents.
Photochemical Smog	Local	Non-methane hydrocarbon (NMHC)	Photochemical Oxident Creation Potential	Converts LCI data to ethane (C_2H_6) equivalents.
Terrestrial Toxicity	Local	Toxic chemicals with a reported lethal concentration to rodents	LC_{50}	Converts LC_{50} data to equivalents; uses multi-media modeling, exposure pathways.
Aquatic Toxicity	Local	Toxic chemicals with a reported lethal concentration to fish	LC_{50}	Converts LC_{50} data to equivalents; uses multi-media modeling, exposure pathways.
Human Health	Global Regional Local	Total releases to air, water, and soil.	LC_{50}	Converts LC_{50} data to equivalents; uses multi-media modeling, exposure pathways.
Resource Depletion	Global Regional Local	Quantity of minerals used Quantity of fossil fuels used	Resource Depletion Potential	Converts LCI data to a ratio of quantity of resource used versus quantity of resource left in reserve.
Land Use	Global Regional Local	Quantity disposed of in a landfill or other land modifications	Land Availability	Converts mass of solid waste into volume using an estimated density.
Water Use	Regional Local	Water used or consumed	Water Shortage Potential	Converts LCI data to a ratio of quantity of water used versus quantity of resource left in reserve.

Step 3: Characterization

Impact characterization uses science-based conversion factors, called characterization factors, to convert and combine the LCI results into representative indicators of impacts to human and ecological health. Characterization factors also are commonly referred to as equivalency factors. Characterization provides a way to directly compare the LCI results within each impact category. In other words, characterization factors translate different inventory inputs into directly comparable impact indicators. For example, characterization would provide an estimate of the relative terrestrial toxicity between lead, chromium, and zinc.

Impact Categories and Associated Endpoints

The following is a list of several impact categories and endpoints that identify the impacts.

Global Impacts

Global Warming - polar melt, soil moisture loss, longer seasons, forest loss/change, and change in wind and ocean patterns.

Ozone Depletion - increased ultraviolet radiation.

Resource Depletion -decreased resources for future generations.

Regional Impacts

Photochemical Smog - "smog," decreased visibility, eye irritation, respiratory tract and lung irritation, and vegetation damage.

Acidification - building corrosion, water body acidification, vegetation effects, and soil effects.

Local Impacts

Human Health - increased morbidity and mortality.

Terrestrial Toxicity - decreased production and biodiversity and decreased wildlife for hunting or viewing.

Aquatic Toxicity - decreased aquatic plant and insect production and biodiversity and decreased commercial or recreational fishing.

Eutrophication – nutrients (phosphorous and nitrogen) enter water bodies, such as lakes, estuaries and slow-moving streams, causing excessive plant growth and oxygen depletion.

Land Use - loss of terrestrial habitat for wildlife and decreased landfill space.

Water Use - loss of available water from groundwater and surface water sources.

Impact indicators are typically characterized using the following equation:

Inventory Data × Characterization Factor = Impact Indicators

For example, all greenhouse gases can be expressed in terms of CO_2 equivalents by multiplying the relevant LCI results by a CO_2 characterization factor and then combining the resulting impact indicators to provide an overall indicator of global warming potential.

Characterization can put these different quantities of chemicals on an equal scale to determine the amount of impact each one has on global warming. The calculations show that ten pounds of methane have a larger impact on global warming than twenty pounds of chloroform.

Characterization of Global Warming Impacts

The following calculations demonstrate how characterization factors can be used to estimate the global warming potential (GWP) of defined quantities of greenhouse gases:

Chloroform GWP Factor Value* = 9 Quantity = 20 pounds
Methane GWP Factor Value* = 21 Quantity = 10 pounds

Chloroform GWP Impact = 20 pounds x 9 = 180
Methane GWP Impact = 10 pounds x 21 = 210

*Intergovernmental Panel on Climate Change (IPCC) Model

The key to impact characterization is using the appropriate characterization factor. For some impact categories, such as global warming and ozone depletion, there is a consensus on acceptable characterization factors. For other impact categories, such as resource depletion, a consensus is still being developed. Exhibit 4-1 describes possible characterization factors for some of the commonly used life cycle impact categories.

A properly referenced LCIA will document the source of each characterization factor to ensure that they are relevant to the goal and scope of the study. For example, many characterization factors are based on studies conducted in Europe. Therefore, the relevancy of the European characterization factors must be investigated before they can be applied to American data.

TRACI

EPA's Tool for the Reduction and Assessment of Chemical and other environmental Impacts (TRACI) is an impact assessment tool that will support consistency in environmental decision making. TRACI allows the examination of the potential for impacts associated with the raw material usage and chemical releases resulting from the processes involved in producing a product. It allows the user to examine the potential for impacts for a single life cycle stage, or the whole life cycle, and to compare the results between products or processes. The purpose of TRACI is to allow a determination or a preliminary comparison of two or more options on the basis of the following environmental impact categories: ozone depletion, global warming, acidification, eutrophication, photochemical smog, human health cancer, human health noncancer, human health criteria, ecotoxicity, fossil fuel use, land use, and water use (EPA 2003).

Step 4: Normalization

Normalization is an LCIA tool used to express impact indicator data in a way that can be compared among impact categories. This procedure normalizes the indicator results by dividing by a selected reference value.

There are numerous methods of selecting a reference value, including:

- The total emissions or resource use for a given area that may be global, regional or local

- The total emissions or resource use for a given area on a per capita basis
- The ratio of one alternative to another (i.e., the baseline)
- The highest value among all options.

The goal and scope of the LCA may influence the choice of an appropriate reference value. Note that normalized data can only be compared within an impact category. For example, the effects of acidification cannot be directly compared with those of aquatic toxicity because the characterization factors were calculated using different scientific methods.

Step 5: Grouping

Grouping assigns impact categories into one or more sets to better facilitate the interpretation of the results into specific areas of concern. Typically, grouping involves sorting or ranking indicators. The following are two possible ways to group LCIA data (ISO 1998):

- Sort indicators by characteristics such as emissions (e.g., air and water emissions) or location (e.g., local, regional, or global).
- Sort indicators by a ranking system, such as high, low, or medium priority. Ranking is based on value choices.

Step 6: Weighting

The weighting step (also referred to as valuation) of an LCIA assigns weights or relative values to the different impact categories based on their perceived importance or relevance. Weighting is important because the impact categories should also reflect study goals and stakeholder values. As stated earlier, harmful air emissions could be of relatively higher concern in an air non-attainment zone than the same emission level in an area with better air quality. Because weighting is not a scientific process, it is vital that the weighting methodology is clearly explained and documented.

Although weighting is widely used in LCAs, the weighting stage is the least developed of the impact assessment steps and also is the one most likely to be challenged for integrity. In general, weighting includes the following activities:

- Identifying the underlying values of stakeholders
- Determining weights to place on impacts
- Applying weights to impact indicators.

Weighted data could possibly be combined across impact categories, but the weighting procedure must be explicitly documented. The un-weighted data should be shown together with the weighted results to ensure a clear understanding of the assigned weights.

Note that in some cases, the presentation of the impact assessment results alone often provides sufficient information for decision-making, particularly when the results are straightforward or obvious. For example, when the best-performing alternative is significantly and meaningfully better than the others in at least one impact category, and equal to the alternatives in the remaining impact categories, then *one alternative is clearly better*. Therefore, any relative weighting of the impact assessment results would not change its rank as first preference. The decision can be made without the weighting step.

Several issues exist that make weighting a challenge. The first issue is subjectivity. According to ISO 14042, any judgment of preferability is a subjective judgment regarding the relative importance of one impact category over another. Additionally, these value judgments may change with location or time of year. For example, someone located in Los Angeles, CA, may place more importance on the values for

photochemical smog than would a person located in Cheyenne, Wyoming. The second issue is derived from the first: how should users fairly and consistently make decisions based on environmental preferability, given the subjective nature of weighting? Developing a truly objective (or universally agreeable) set of weights or weighting methods is not feasible. However, several approaches to weighting do exist and are used successfully for decision-making, such as the Analytic Hierarchy Process, the Modified Delphi Technique, and Decision Analysis Using Multi-Attribute Theory.

Step 7: Evaluate and Document the LCIA Results

Now that the impact potential for each selected category has been calculated, the accuracy of the results must be verified. The accuracy must be sufficient to support the purposes for performing the LCA as defined in the goal and scope. When documenting the results of the life cycle impact assessment, thoroughly describe the methodology used in the analysis, define the systems analyzed and the boundaries that were set, and all assumptions made in performing the inventory analysis.

The LCIA, like all other assessment tools, has inherent limitations. Although the LCIA process follows a systematic procedure, there are many underlying assumptions and simplifications, as well subjective value choices.

Depending on the LCIA methodology selected, and/or the inventory data on which it is based, some of the key limitations may include:

- Lack of spatial resolution – e.g., a 4,000-gallon ammonia release is worse in a small stream than in a large river.
- Lack of temporal resolution – e.g., a five-ton release of particulate matter during a one month period is worse than the same release spread through the whole year.
- Inventory speciation – e.g., broad inventory listing such as “VOC” or “metals” do not provide enough information to accurately assess environmental impacts.
- Threshold and non-threshold impact – e.g., ten tons of contamination is not necessarily ten times worse than one ton of contamination.

The selection of more complex or site-specific impact models can help reduce the limitations of the impact assessment’s accuracy. It is important to document these limitations and to include a comprehensive description of the LCIA methodology, as well as a discussion of the underlying assumptions, value choices, and known uncertainties in the impact models with the numerical results of the LCIA to be used in interpreting the results of the LCA.

Chapter 5
Life Cycle Interpretation

What is Life Cycle Interpretation?
Life cycle interpretation is a systematic technique to identify, quantify, check, and evaluate information from the results of the LCI and the LCIA, and communicate them effectively. Life cycle interpretation is the last phase of the LCA process.

ISO has defined the following two objectives of life cycle interpretation:

1. Analyze results, reach conclusions, explain limitations, and provide recommendations based on the findings of the preceding phases of the LCA, and to report the results of the life cycle interpretation in a transparent manner.
2. Provide a readily understandable, complete, and consistent presentation of the results of an LCA study, in accordance with the goal and scope of the study. (ISO 1998b)

Comparing Alternatives Using Life Cycle Interpretation
Interpreting the results of an LCA is not as simple as two is better then three, therefore Alternative A is the best choice! While conducting the LCI and LCIA it is necessary to make assumptions, engineering estimates, and decisions based on your values and the values of involved stakeholders. Each of these decisions must be included and communicated within the final results to clearly and comprehensively explain conclusions drawn from the data. In some cases, it may not be possible to state that one alternative is better than the others because of the uncertainty in the final results. This does not imply that efforts have been wasted. The LCA process will still provide decision-makers with a better understanding of the environmental and health impacts associated with each alternative, where they occur (locally, regionally, or globally), and the relative magnitude of each type of impact in comparison to each of the proposed alternatives included in the study. This information more fully reveals the pros and cons of each alternative.

Can I Select an Alternative Based Only on the Results of the LCA?
The purpose of conducting an LCA is to better inform decision-makers by providing a particular type of information (often unconsidered), with a life cycle perspective of environmental and human health impacts associated with each product or process. However, LCA does not take into account technical performance, cost, or political and social acceptance. Therefore, it is recommended that LCA be used in conjunction with these other parameters.

Key Steps to Interpreting the Results of the LCA
The guidance provided in this chapter is a summary of the information provided on life cycle interpretation from the ISO standard entitled "*Environmental Management - Life Cycle Assessment - Life Cycle Interpretation*," ISO 14043 (ISO 1998b). Within the ISO standard, the following steps to conducting a life cycle interpretation are identified and discussed:

1. Identification of the Significant Issues Based on the LCI and LCIA.
2. Evaluation which Considers Completeness, Sensitivity, and Consistency Checks.
3. Conclusions, Recommendations, and reporting.

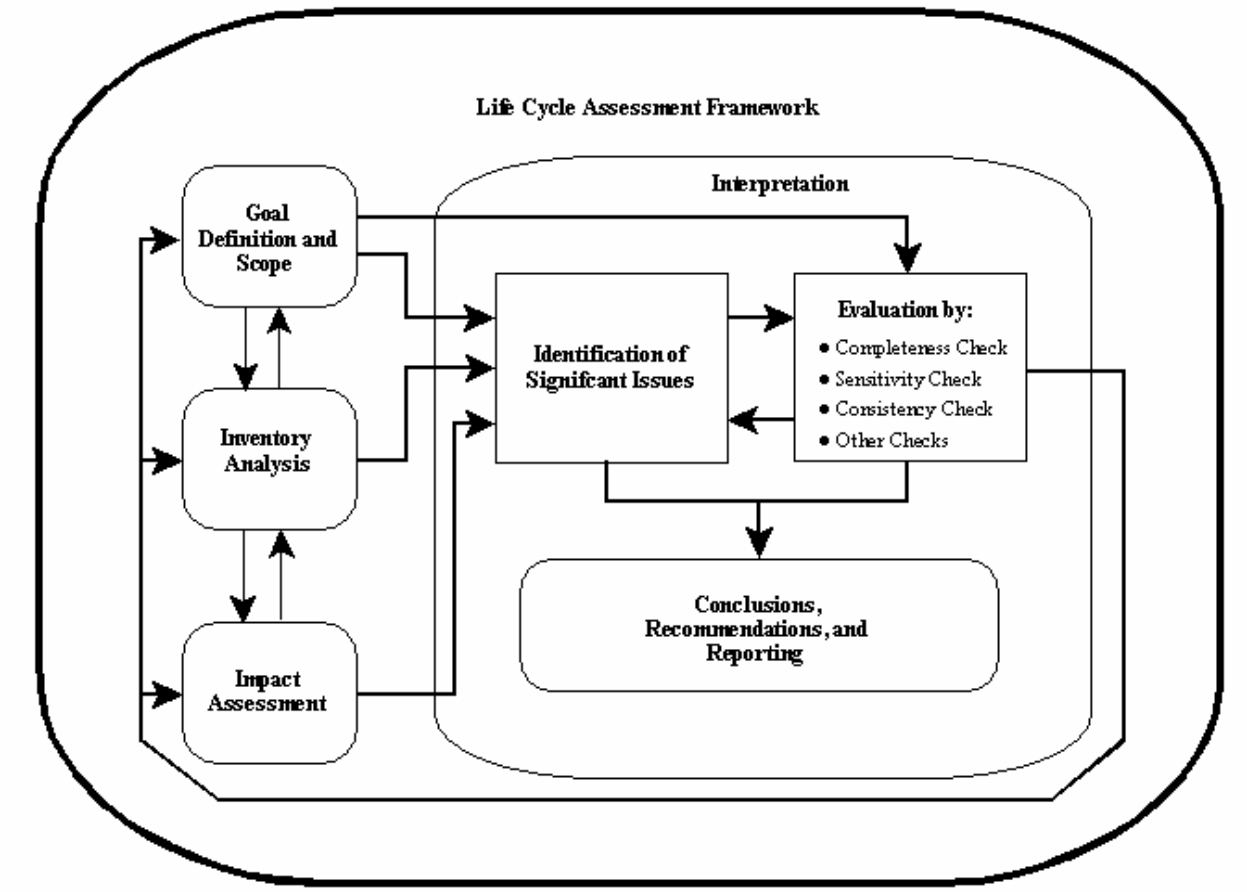


Exhibit 5-1. Relationship of Interpretation Steps with other Phases of LCA (Source: ISO, 1998b)

Exhibit 5-1 illustrates the steps of the life cycle interpretation process in relation to the other phases of the LCA process. Each step is summarized below.

Step 1: Identify Significant Issues

The first step of the life cycle interpretation phase involves reviewing information from the first three phases of the LCA process in order to identify the data elements that contribute most to the results of both the LCI and LCIA for each product, process, or service, otherwise known as "significant issues."

The results of this effort are used to evaluate the completeness, sensitivity, and consistency of the LCA study (Step 2). The identification of significant issues guides the evaluation step. Because of the extensive amount of data collected, it is only feasible within reasonable time and resources to assess the data elements that contribute significantly to the outcome of the results.

Before determining which parts of the LCI and LCIA have the greatest influence on the results for each alternative, the previous phases of the LCA should be reviewed in a comprehensive manner (e.g., study goals, ground rules, impact category weights, results, external involvement, etc.).

Review the information collected and the presentations of results developed to determine if the goal and scope of the LCA study have been met. If they have, the significance of the results can then be determined.

Determining significant issues of a product system may be simple or complex. For assistance in identifying environmental issues and determining their significance, the following approaches are recommended:

- *Contribution Analysis* - the contribution of the life cycle stages or groups of processes are compared to the total result and examined for relevance.
- *Dominance Analysis* - statistical tools or other techniques, such as quantitative or qualitative ranking (e.g., ABC Analysis), are used to identify significant contributions to be examined for relevance.
- *Anomaly Assessment* - based on previous experience, unusual or surprising deviations from expected or normal results are observed and examined for relevance.

Significant issues can include:

- Inventory parameters like energy use, emissions, waste, etc.
- Impact category indicators like resource use, emissions, waste, etc.
- Essential contributions for life cycle stages to LCI or LCIA results such as individual unit processes or groups of processes (e.g., transportation, energy production).

Step 2: Evaluate the Completeness, Sensitivity, and Consistency of the Data

The evaluation step of the interpretation phase establishes the confidence in and reliability of the results of the LCA. This is accomplished by completing the following tasks to ensure that products/processes are fairly compared:

1. Completeness Check - examining the completeness of the study.
2. Sensitivity Check - assessing the sensitivity of the significant data elements that influence the results most greatly.
3. Consistency Check - evaluating the consistency used to set system boundaries, collect data, make assumptions, and allocate data to impact categories for each alternative.

Each technique is summarized below.

Completeness Check - The completeness check ensures that all relevant information and data needed for the interpretation are available and complete. A checklist should be developed to indicate each significant area represented in the results. Data can be organized by life cycle stage, different processes or unit operations, or type of data represented (raw materials, energy, transportation, environmental release to air, land, or water). Using the established checklist, it is possible to verify that the data comprising each area of the results are consistent with the system boundaries (e.g., all life cycle stages are included) and that the data is representative of the specified area (e.g., accounting for 90 percent of all raw materials and environmental releases). The result of this effort will be a checklist indicating that the results for each product/process are complete and reflective of the stated goals and scope of the LCA study. If deficiencies are noted, then a fair comparison cannot be performed and additional efforts are required to fill the gaps. In some cases, data may not be available to fill the data gaps; under these circumstances, it is necessary to report the differences in the data with the final results and estimate the impact to the comparison either quantitatively (percent uncertainty) or qualitatively (Alternative A's reported result may be higher because "X" is not included in its assessment).

Sensitivity Check - The objective of the sensitivity check is to evaluate the reliability of the results by determining whether the uncertainty in the significant issues identified in Step 1 affect the decision-

maker's ability to confidently draw comparative conclusions. A sensitivity check can be performed on the significant issues using the following three common techniques for data quality analysis:

1. Contribution Analysis – Identifies the data that has the greatest contribution on the impact indicator results.

2. Uncertainty Analysis – Describes the variability of the LCIA data to determine the significance of the impact indicator results.

3. Sensitivity Analysis – Measures the extent that changes in the LCI results and characterization models affect the impact indicator results.

Additional guidance on how to conduct a contribution, uncertainty, or sensitivity analysis can be found in the EPA document entitled "Guidelines for Assessing the Quality of Life Cycle Inventory Analysis," April 1995, EPA 530-R-95-010. As part of the LCI and LCIA phases, a sensitivity, uncertainty, and/or contribution analysis may have been conducted. These results can be used as the sensitivity check. As part of the goal, scope, and definition phase of the LCA process, the data quality and accuracy goals were defined. Verify that these goals have been met with the sensitivity check. If deficiencies exist, then the accuracy of the results may not be sufficient to support the decisions to be made and additional efforts are required to improve the accuracy of the LCI data collected and/or impact models used in the LCIA. In some cases, better data or impact models may not be available. Under these circumstances, report the deficiencies for each relevant significant issue and estimate the impact to the comparison either quantitatively or qualitatively.

Consistency Check - The consistency check determines whether the assumptions, methods, and data used throughout the LCA process are consistent with the goal and scope of the study, and for each product/process evaluated. Verifying and documenting that the study was completed as intended at the conclusion increases confidence in the final results.

A formal checklist should be developed to communicate the results of the consistency check. Exhibit 5-2 provides examples of the types of information to be included in the checklist. The goal and scope of the LCA determines which categories should be used.

Depending upon the goal and scope of the LCA, some inconsistency may be acceptable. If any inconsistency is detected, document the role it played in the overall consistency evaluation.

After completing steps 1 and 2, it has been determined that the results of the impact assessment and the underlying inventory data are complete, comparable, and acceptable to draw conclusions and make recommendations. If this is not true, stop! Repeat steps 1 and 2 until the results will be able to support the original goals for performing the LCA.

Exhibit 5-2. Examples of Checklist Categories and Potential Inconsistencies

Category	Example of Inconsistency
Data Source	Alternative A is based on literature and Alternative B is based on measured data.
Data Accuracy	For Alternative A, a detailed process flow diagram is used to develop the LCI data. For Alternative B, limited process information was available and the LCI data developed was for a process that was not described or analyzed in detail.
Data Age	Alternative A uses 1980's era raw materials manufacturing data. Alternative B used a one year-old study.
Technological Representation	Alternative A is bench-scale laboratory model. Alternative B is a full-scale production plant operation.
Temporal Representation	Data for Alternative A describe a recently developed technology. Alternate B describes a technology mix, including recently built and old plants.
Geographical Representation	Data for Alternative A were data from technology employed under European environmental standards. Alternative B uses the data from technology employed under U.S. environmental standards.
System Boundaries, Assumptions, & Models	Alternative A uses a Global Warming Potential model based on 500 year potential. Alternative B uses a Global Warming Potential model based on 100 year potential.

Step 3: Draw Conclusions and Recommendations

The objective of this step is to interpret the results of the life cycle impact assessment (not the LCI) to determine which product/process has the overall least impact to human health and the environment, and/or to one or more specific areas of concern as defined by the goal and scope of the study.

Depending upon the scope of the LCA, the results of the impact assessment will return either a list of un-normalized and un-weighted impact indicators for each impact category for the alternatives, or it will return a single grouped, normalized, and weighted score for each alternative, or something in between, e.g., normalized but not weighted.

In the case where a score is calculated, the recommendation may be to accept the product/process with the lowest score. Or, it could be to investigate the reasons how the process could be modified to lower the score. However, do not forget the underlying assumptions that went into the analysis.

If an LCIA stops at the characterization stage, the LCIA interpretation is less clear-cut. The conclusions and recommendations rest on balancing the potential human health and environmental impacts in the light of study goals and stakeholder concerns.

A few words of caution should be noted. It is important to draw conclusions and provide recommendations based only on the facts. Understanding and communicating the uncertainties and limitations in the results is equally as important as the final recommendations. In some instances, it may not be clear which product or process is better because of the underlying uncertainties and limitations in the methods used to conduct the LCA or the availability of good data, time, or resources. In this situation, the results of the LCA are still valuable. They can be used to help inform decision-makers about the human health and environmental pros and cons, understanding the significant impacts of each, where they are occurring (locally, regionally, or globally), and the relative magnitude of each type of impact in comparison to each of the proposed alternatives included in the study.

Reporting the Results
Now that the LCA has been completed, the materials must be assembled into a comprehensive report documenting the study in a clear and organized manner. This will help communicate the results of the assessment fairly, completely, and accurately to others interested in the results. The report presents the results, data, methods, assumptions, and limitations in sufficient detail to allow the reader to comprehend the complexities and trade-offs inherent in the LCA study.

If the results will be reported to someone who was not involved in the LCA study, i.e., third-party stakeholders, this report will serve as a reference document and should be provided to them to help prevent any misrepresentation of the results.

The reference document should consist of the following elements (ISO 1997):

1. Administrative Information
    a. Name and address of LCA practitioner (who conducted the LCA study)
    b. Date of report
    c. Other contact information or release information
2. Definition of Goal and Scope
3. Life Cycle Inventory Analysis (data collection and calculation procedures)
4. Life Cycle Impact Assessment (methodology and results of the impact assessment that was performed)
5. Life Cycle Interpretation
    a. Results
    b. Assumptions and limitations
    c. Data quality assessment
6. Critical Review (internal and external)
    a. Name and affiliation of reviewers
    b. Critical review reports
    c. Responses to recommendations

Critical Review
The desirability of a peer review process has been a major focus of discussion in many life-cycle analysis forums. The discussion stems from concerns in four areas; lack of understanding regarding the methodology used or the scope of the study, desire to verify data and the analyst's compilations of data, questioning key assumptions and the overall results, and communication of results. For these reasons, it is recommended that a peer review process be established and implemented early in any study that will be used in a public forum.

The following discussion is not intended to be a blueprint of a specific approach. Instead, it is meant to point out issues that the practitioner or sponsor should keep in mind when establishing a peer review procedure. Overall, a peer review process should address the four areas previously identified:

- Scope/boundaries methodology
- Data acquisition/compilation
- Validity of key assumptions and results
- Communication of results.

The peer review panel should participate in all phases of the study: (1) reviewing the purpose, system boundaries, assumptions, and data collection approach; (2) reviewing the compiled data and the associated quality measures; and, (3) reviewing the draft inventory report, including the intended communication strategy.

A spreadsheet, such as the one presented in Appendix A would be useful in addressing many of the issues surrounding scope/boundaries methodology, data/compilation of data, and validity of assumptions and results. Criteria may need to be established for communication of results. These criteria could include showing how changes in key assumptions could affect the study results, and guidance on how to publish and communicate results without disclosing proprietary data.

It is generally believed that the peer review panel should consist of a diverse group of three to five individuals representing various sectors, such as federal, state, and local governments, academia, industry, environmental or consumer groups, and LCA practitioners. Not all sectors need be represented on every panel. The credentials or background of individuals should include a reputation for objectivity, experience with the technical framework or conduct of life-cycle analysis studies, and a willingness to work as part of a team. Issues for which guidelines are still under development include panel selection, number of reviews, using the same reviewers for all life-cycle studies or varying the members between studies, and having the review open to the public prior to its release. The issue of how the reviews should be performed raises a number of questions, such as these: Should a standard spreadsheet be required? Should oral as well as written comments from the reviewers be accepted? How much time should be allotted for review? Who pays for the review process?

The peer review process should be flexible to accommodate variations in the application or scope of life-cycle studies. Peer review should improve the conduct of these studies, increase the understanding of the results, and aid in further identifying and subsequently reducing any environmental consequences of products or materials. EPA supports the use of peer reviews as a mechanism to increase the quality and consistency of life-cycle inventories.

Conclusion

Adding life cycle assessment to the decision-making process provides an understanding of the human health and environmental impacts that traditionally is not considered when selecting a product or process. This valuable information provides a way to account for the full impacts of decisions, especially those that occur outside of the site that are directly influenced by the selection of a product or process.

Remember, LCA is a tool to better inform decision-makers and should be included with other decision criteria, such as cost and performance, to make a well-balanced decision.

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Appendix A
Sample Inventory Spreadsheet

(This is a fictitious example of the life cycle inventory for a gasoline system and does not represent real data).

PROCESS NAME:			Fictitious Gasoline Life Cycle Inventory							
PROCESS ID:			Gasoline							
REFERENCE FLOW:			1000		Units:	gallons	of:	Gasoline		
PROCESS DESCRIPTION:			Summary of LCI to extract, produce, and distribute 1,000 gallons of gasoline used							
			to fuel a typical passenger automobile in the US.							
BASIS OF CALCULATIONS										
				Summer	Winter	Average	Units	Reference		
	Oxygen Content			2.1	1.9	0.02	percent	EPA, OTAQ; MOBILE 6		
	Molecular Weight					88	g/mol	www.chemfinder.com		
	Oxygenate Content by Volume					11.05	percent by volume			
	Oxygenate Content by Weight					11.15	percent by weight			
	Fuel Economy Estimated for Average Car By Fuel Type					20.22	miles/gal	MOBILE 6		
	Petroleum Refining Process Efficiency (mass outputs/mass inputs)									
		Petroleum Refinery Process Efficiency (mass basis)				92	percent	EIA		
		GREET v1.6 Published Petroleum Refinery Efficiency				85	percent	Greet1.6		
		Process Efficiency Used in Calculations				85	percent			
Process Inputs										
	Material	Coal					9.88E+01	lb		
		Crude Oil					5.64E+02	gal		
		Natural Gas					3.23E+02	SCF		
		Uranium					6.69E-02	lb		
		Wood					3.99E+00	lb		
		Drilling Fluids					Unknown			
Process Outputs										
	Product	Gasoline					594	gal	Calculated	
	Co-Product	N/A								
	Air Emissions									

			Mat. P&D	Fuel P&D	Fuel Use	Process	Total	Units		
		Volatile Organic Compounds (VOC)	1.86E-01	1.49E-01	2.98E-01	1.36E+01	1.42E+01	lb		
		Carbon Monoxide (CO)	4.69E-01	4.78E-01	2.32E+00	3.00E+02	3.03E+02	lb		
		Nitrogen Oxides (NOx)	1.51E+00	1.64E+00	8.33E+00	2.26E+01	3.41E+01	lb		
		PM10	6.16E-02	2.06E-01	2.45E-01	6.79E-01	1.19E+00	lb		
		Sulfur Oxides (SOx)	6.41E-01	2.17E+00	2.52E+00	1.44E+00	6.77E+00	lb		
		Methane	5.60E-01	1.26E+00	3.18E-01	1.70E+00	3.84E+00	lb		
		Nitrous Oxide (N2O)	3.91E-03	4.38E-03	2.85E-02		3.68E-02	lb		
		Carbon Dioxide (CO2)	2.20E+02	3.75E+02	1.56E+03	1.20E+04	1.41E+04	lb		
		VOC loss: evaporation				1.39E+01	1.39E+01	lb		
		VOC loss: spillage	2.70E-04	2.36E-03			2.62E-03	lb		
		1 1 1-Trichloroethane				2.19E-05	2.19E-05	lb		
		1 2 3-Trichloropropane				9.67E-06	9.67E-06	lb		
		1 2 4-Trichlorobenzene				5.8E-07	5.8E-07	lb		
		1 2 4-Trimethylbenzene	1.07E-04	1.02E-04		1.23E-01	1.23E-01	lb		
		1 2-Dibromoethane	1.24E-06	1.19E-06		1.61E-05	1.86E-05	lb		
		1 2-Dichloroethane	3.2E-06	3.06E-06		4.15E-05	4.78E-05	lb		
		1 3-Butadiene	2.9E-05	2.77E-05		8.39E-02	8.40E-02	lb		
		2 2 4-TM-Pentane				1.20E+00	1.20E+00	lb		
		2 2 5-TM-Hexane				1.39E-01	1.39E-01	lb		
		2 3 3-TM-Pentane				2.22E-01	2.22E-01	lb		
		2 3 4-TM-Pentane				2.21E-01	2.21E-01	lb		
		2 3-Dimethylbutane				1.39E-01	1.39E-01	lb		
		2 4-Dimethylphenol				1.01E-07	1.01E-07	lb		
		2-Methyl-2-butene				9.19E-02	9.19E-02	lb		
		2-Methylhexane				1.57E-01	1.57E-01	lb		
		2-Methylpentane				2.84E-01	2.84E-01	lb		
		3-Methylhexane				1.64E-01	1.64E-01	lb		
		3-Methylpentane				1.82E-01	1.82E-01	lb		
		Acenaphthene				9.23E-05	9.23E-05	lb		
		Acenaphthylene				5.20E-04	5.20E-04	lb		
		Acetonitrile				4.29E-06	4.29E-06	lb		
		Acetophenone				2.75E-06	2.75E-06	lb		
		Acreolin	4.29E-07	3.2E-06	1.57E+03	8.21E-03	8.21E-03	lb		
		Aluminum (fume or dust)				2.36E-08	2.36E-08	lb		

		Ammonia	1.32E-03	2.43E-03		2.68E+00	2.68E+00	lb		
		Anthracene	5.88E-07	5.62E-07		1.14E-04	1.16E-04	lb		
		Antimony	2.17E-07	1.62E-06		1.85E-06	3.69E-06	lb		
		Antimony Compounds	5.9E-07	5.64E-07		7.65E-06	8.80E-06	lb		
		Arsenic	9.85E-07	7.34E-06		7.60E-05	8.43E-05	lb		
		Asbestos (friable)					0.00E+00	lb		
		Barium				8.80E-08	8.80E-08	lb		
		Barium Compounds				1.05E-06	1.05E-06	lb		
		Benzene	1.60E-03	2.26E-03		6.38E-01	6.42E-01	lb		
		Benzo(a)anthracene				1.30E-05	1.30E-05	lb		
		Benzo(a)pyrene				1.30E-05	1.30E-05	lb		
		Benzo(b)fluoranthene				1.54E-05	1.54E-05	lb		
		Benzo(g,h,i)perylene				3.24E-05	3.24E-05	lb		
		Benzo(k)fluoranthene				1.54E-05	1.54E-05	lb		
		Beryllium	1.12E-07	8.35E-07			9.47E-07	lb		
		Biphenyl	2.31E-05	1.05E-05		3.73E-04	4.06E-04	lb		
		Butraldehyde				5.58E-06	5.58E-06	lb		
		Cadmium	2.14E-07	1.6E-06		2.79E-08	1.84E-06	lb		
		Carbon Disulfide	1.89E-06	1.81E-06		2.45E-05	2.83E-05	lb		
		Carbon Tetrachloride	2.43E-06	7.29E-06		2.16E-05	3.13E-05	lb		
		Carbonyl Sulfide	5.23E-05	5.01E-05		7.58E-05	1.78E-04	lb		
		Certain Glycol Ethers				3.11E-05	3.11E-05	lb		
		Chlorine	4.06E-05	3.97E-05		5.25E-04	6.05E-04	lb		
		Chlorine Dioxide				4.29E-09	4.29E-09	lb		
		Chlorobenzene					0.00E+00	lb		
		Chlorodifluoromethane	8.34E-06	7.99E-06		1.08E-04	1.25E-04	lb		
		Chloromethane				2.97E-06	2.97E-06	lb		
		Chromium	1.28E-06	9.52E-06		7.51E-08	1.09E-05	lb		
		Chromium Compounds	9.85E-08	9.42E-08		1.28E-06	1.47E-06	lb		
		Chromium III				7.85E-05	7.85E-05	lb		
		Chromium VI				5.23E-05	5.23E-05	lb		
		Chrysene				1.30E-05	1.30E-05	lb		
		Cobalt	7.22E-07	4.86E-06		3.22E-08	5.62E-06	lb		
		Cobalt Compounds	2.48E-09	2.38E-09		1.02E-06	1.03E-06	lb		
		Copper				3.01E-08	3.01E-08	lb		

		Copper Compounds	3.2E-07	3.07E-07		4.16E-06	4.78E-06	lb		
		Cresol (mixed Isomers)	3.87E-06	3.7E-06		5.02E-05	5.78E-05	lb		
		Cumene	1.42E-03	3.36E-03		5.10E-03	9.88E-03	lb		
		Cumene Hydroperoxide				1.09E-05	1.09E-05	lb		
		Cyanide Compounds				8.07E-05	8.07E-05	lb		
		Cyclohexane	2.54E-04	2.43E-04		3.30E-03	3.79E-03	lb		
		Dibenz(a,h)anthracene					0.00E+00	lb		
		Dicyclopentadiene				3.94E-06	3.94E-06	lb		
		Diethanolamine	2.94E-05	2.82E-05		3.82E-04	4.40E-04	lb		
		Dioxins	2.36E-12	1.76E-11			1.99E-11	lb		
		Ethylbenzene	7.00E-04	1.11E-03		3.44E-01	3.46E-01	lb		
		Ethylene	3.62E-04	3.46E-04		4.69E-03	5.40E-03	lb		
		Ethylene Glycol	1.89E-05	1.81E-05		2.45E-04	2.82E-04	lb		
		Ethylene Oxide				4.29E-06	4.29E-06	lb		
		Formaldehyde	2.93E-05	3.95E-05		2.32E-01	2.32E-01	lb		
		Fluoranthene				1.15E-04	1.15E-04	lb		
		Fluorene				1.91E-04	1.91E-04	lb		
		Hydrazine				1.63E-06	1.63E-06	lb		
		Hydocarbons (non CH4)	2.49E-02	1.86E-01			2.11E-01	lb		
		Hydrochloric Acid	2.27E-03	1.63E-02		1.26E-03	1.98E-02	lb		
		Hydrogen Cyanide				4.21E-05	4.21E-05	lb		
		Hydrogen Fluoride	3.50E-04	2.28E-03		6.52E-04	3.28E-03	lb		
		Indeno(123cd)pyrene				9.71E-06	9.71E-06	lb		
		Isopentane		4.1E-07		4.55E-01	4.55E-01	lb		
		Isopropyl Alcohol				3.59E-06	3.59E-06	lb		
		Kerosene	1.09E-05	8.09E-05			9.18E-05	lb		
		Lead	1.73E-06	1.29E-05		1.29E-08	1.46E-05	lb		
		Lead Compounds	2.08E-07	1.99E-07		2.69E-06	3.10E-06	lb		
		m-Xylene	9.61E-04	1.66E-03		4.01E-03	6.63E-03	lb		
		Manganese	2.97E-06	2.21E-05		4.43E-05	6.94E-05	lb		
		Manganese Compounds				2.23E-06	2.23E-06	lb		
		Mercury	8.13E-07	6.06E-06		2.31E-05	3.00E-05	lb		
		Mercury Compounds				1.29E-07	1.29E-07	lb		
		Metals	4.5E-06	3.35E-05			3.80E-05	lb		
		Methanol	1.05E-03	1.00E-03		1.36E-02	1.57E-02	lb		

		Methyl Ethyl Ketone	4.91E-04	4.70E-04		6.37E-03	7.33E-03	lb		
		Methyl Isobutyl Ketone	3.37E-05	3.22E-05		4.37E-04	5.03E-04	lb		
		Methyl Tert-Butyl Ether	3.42E-04	3.27E-04		2.30E+00	2.30E+00	lb		
		Methylene Chloride	1.85E-06	1.38E-05		0.00E+00	1.56E-05	lb		
		Molybdenum Trioxide	4.50E-07	4.31E-07		5.84E-06	6.72E-06	lb		
		n-Butane				1.10E-01	1.10E-01	lb		
		n-Butyl Alcohol				2.45E-05	2.45E-05	lb		
		n-Pentane	7.21E-04	5.29E-04		1.91E-01	1.92E-01	lb		
		n-Hexane	7.21E-04	6.90E-04		4.13E-01	4.14E-01	lb		
		n-Heptane				1.90E-01	1.90E-01	lb		
		n-Octane				4.12E-03	4.12E-03	lb		
		n-nonane				3.19E-03	3.19E-03	lb		
		n-Decane				3.07E-03	3.07E-03	lb		
		n-Undecane				1.75E-03	1.75E-03	lb		
		n-Dodecane				2.31E-03	2.31E-03	lb		
		n-Tridecane				2.74E-03	2.74E-03	lb		
		n-Tetradecane				2.97E-03	2.97E-03	lb		
		n-Pentadecane				2.83E-03	2.83E-03	lb		
		n-Hexadecane				2.67E-03	2.67E-03	lb		
		n-Heptadecane				2.62E-03	2.62E-03	lb		
		n-Octadecane				1.60E-03	1.60E-03	lb		
		n-Nonadecane				1.95E-03	1.95E-03	lb		
		n-Icosane				1.79E-03	1.79E-03	lb		
		n-Henicosane				1.66E-03	1.66E-03	lb		
		n-Docosane				1.62E-03	1.62E-03	lb		
		n-Methyl-2-Pyrrolidone	3.8E-05	3.64E-05		4.93E-04	5.67E-04	lb		
		n-Nitrodimethylamine	9.06E-08	6.75E-07			7.66E-07	lb		
		Naphthalene	7.36E-05	5.09E-05		1.76E-02	1.77E-02	lb		
		Nickel	6.68E-06	4.83E-05		9.81E-05	1.53E-04	lb		
		Nickel Compounds	5.81E-06	5.56E-06		7.53E-05	8.67E-05	lb		
		Nitrate Compounds					0.00E+00	lb		
		o-Xylene	9.39E-04	1.64E-03		3.73E-03	6.31E-03	lb		
		Other Aldehydes	8.17E-05	6.08E-04			6.90E-04	lb		
		Other Organics	1.24E-04	9.27E-04			1.05E-03	lb		
		p-Xylene	9.94E-04	1.69E-03		1.61E-03	4.30E-03	lb		

		Particulates (total)	3.61E-02	2.69E-01		0.00E+00	3.05E-01	lb		
		Perchloroethylene	4.10E-07	3.05E-06		0.00E+00	3.46E-06	lb		
		Phenanthrene	3.00E-05	1.31E-05		4.81E-04	5.24E-04	lb		
		Phenols	2.52E-05	3.15E-05		3.12E-04	3.69E-04	lb		
		Polycyclic Aromatic Compounds	7.74E-06	7.41E-06		1.00E-04	1.16E-04	lb		
		Propionaldehyde				8.97E-03	8.97E-03	lb		
		Propylene	6.65E-04	6.36E-04		8.63E-03	9.93E-03	lb		
		Pyrene				1.57E-04	1.57E-04	lb		
		Quinoline				1.01E-05	1.01E-05	lb		
		Radionuclides (Ci)	8.90E-06	6.63E-05			7.52E-05	lb		
		Selenium	3.09E-06	2.30E-05			2.61E-05	lb		
		Selenium Compounds				1.07E-07	1.07E-07	lb		
		Styrene	1.23E-06	1.18E-06		4.10E-02	4.10E-02	lb		
		Sulfuric Acid	1.36E-03	1.30E-03		1.76E-02	2.03E-02	lb		
		Tert-Butyl Alcohol	9.20E-07	8.81E-07		1.19E-05	1.37E-05	lb		
		Tetrachloroethylene	1.03E-05	9.81E-06		1.33E-04	1.53E-04	lb		
		Toluene	3.36E-03	4.36E-03		2.00E+00	2.00E+00	lb		
		Toluene-2 6-Diisocyanate				4.14E-06	4.14E-06	lb		
		Trichloroethylene	1.08E-05	1.30E-05		1.35E-04	1.59E-04	lb		
		Vanadium				5.93E-06	5.93E-06	lb		
		Vinyl Acetate				1.51E-05	1.51E-05	lb		
		Xylene (mixed isomers)	5.52E-04	5.28E-04		1.31E+00	1.31E+00	lb		
		Zinc (fume or dust)	1.09E-06	1.05E-06		1.42E-05	1.63E-05	lb		
		Zinc Compounds	8.05E-06	7.71E-06		1.04E-04	1.20E-04	lb		
		Acetaldehyde	0.00E+00	0.00E+00		6.72E-02	6.72E-02	lb		
		Total	2.24E+02	3.85E+02	1.57E+03	1.24E+04	1.45E+04	lb		
	Water Emissions									
			Mat. P&D	Fuel P&D	Fuel Use	Process	Total	Units		
		1 1 1-Trichloroethane					0.00E+00	lb		
		1 2 3-Trichloropropane					0.00E+00	lb		
		1 2 4-Trichlorobenzene					0.00E+00	lb		
		1 2 4-Trimethylbenzene	3.99E-07	1.6E-06		2.17E-01	2.17E-01	lb		
		1 2-Dibromoethane	9.6E-10	9.41E-10		1.29E-08	1.48E-08	lb		
		1 2-Dichloroethane				2.15E-09	2.15E-09	lb		
		1 3-Butadiene	1.27E-07	1.25E-07		1.70E-06	1.96E-06	lb		

		2 2 4-TM-Pentane				7.97E-01	7.97E-01	lb		
		2 2 5-TM-Hexane				2.49E-01	2.49E-01	lb		
		2 3 3-TM-Pentane				3.96E-01	3.96E-01	lb		
		2 3 4-TM-Pentane				3.95E-01	3.95E-01	lb		
		2 3-Dimethylbutane				2.49E-01	2.49E-01	lb		
		2 4-Dimethylphenol				2.25E-07	2.25E-07	lb		
		2-Methyl-2-Butene				1.64E-01	1.64E-01	lb		
		2-Methylhexane				2.80E-01	2.80E-01	lb		
		2-Methylpentane				5.07E-01	5.07E-01	lb		
		3-Methylhexane				2.93E-01	2.93E-01	lb		
		3-Methylpentane				3.25E-01	3.25E-01	lb		
		Acetaldehyde				5.25E-07	5.25E-07	lb		
		Acetonitrile					0.00E+00	lb		
		Acetophenone					0.00E+00	lb		
		Acid	4.96E-10	3.7E-09			4.19E-09	lb		
		Aluminum (fume or dust)					0.00E+00	lb		
		Ammonia	1.02E-04	2.25E-04		1.11E-03	1.44E-03	lb		
		Anthracene				8.07E-07	8.07E-07	lb		
		Antimony				9.17E-07	9.17E-07	lb		
		Antimony Compounds	1.51E-07	1.48E-07		2.03E-06	2.33E-06	lb		
		Arsenic				8.37E-08	8.37E-08	lb		
		Barium				3.99E-06	3.99E-06	lb		
		Barium Compounds				1.37E-05	1.37E-05	lb		
		Benzene	4.25E-04	1.16E-03		8.58E-02	8.73E-02	lb		
		Beryllium				4.94E-08	4.94E-08	lb		
		Biphenyl	0.00E+00	1.15E-06		7.19E-07	1.87E-06	lb		
		Biological Oxygen Demand (BOD)	1.11E-03	8.31E-03			9.42E-03	lb		
		Boron	5.46E-06	4.07E-05			4.62E-05	lb		
		Cadmium	3.60E-04	2.83E-04		1.63E-03	2.27E-03	lb		
		Carbon Disulfide				8.59E-09	8.59E-09	lb		
		Certain Glycol Ethers				3.33E-06	3.33E-06	lb		
		Chlorine	2.56E-06	2.51E-06		3.43E-05	3.94E-05	lb		
		Chromates	5.46E-06	4.07E-05			4.62E-05	lb		
		Chromium				5.65E-07	5.65E-07	lb		
		Chromium Compounds	9.24E-07	9.05E-07		1.24E-05	1.42E-05	lb		

		Cobalt				4.81E-06	4.81E-06	lb		
		Cobalt Compounds				3.18E-06	3.18E-06	lb		
		Copper				1.07E-08	1.07E-08	lb		
		Copper Compounds	3.42E-07	3.35E-07		4.59E-06	5.27E-06	lb		
		Cresol (mixed isomers)	3.43E-07	3.36E-07		4.60E-06	5.28E-06	lb		
		Cumene	7.80E-04	4.13E-03		1.92E-03	6.83E-03	lb		
		Cyclohexane	3.15E-07	3.09E-07		4.23E-06	4.85E-06	lb		
		Diethanolamine	1.21E-01	9.00E-01		2.55E-05	1.02E+00	lb		
		Ethylbenzene	2.26E-04	7.83E-04		1.40E-01	1.41E-01	lb		
		Ethylene				1.42E-06	1.42E-06	lb		
		Ethylene Glycol	4.48E-05	3.24E-04		2.02E-05	3.89E-04	lb		
		Fluorine				5.71E-05	5.71E-05	lb		
		Hydrogen Fluoride				1.52E-07	1.52E-07	lb		
		Iron	6.62E-01	4.03E-01		3.08E+00	4.14E+00	lb		
		Isopentane				9.86E-01	9.86E-01	lb		
		Lead				1.42E-07	1.42E-07	lb		
		Lead Compounds	1.40E-07	1.37E-07		1.87E-06	2.15E-06	lb		
		m-Xylene				1.41E-03	1.41E-03	lb		
		Manganese	2.64E-02	1.61E-02		1.23E-01	1.65E-01	lb		
		Manganese Compounds				3.41E-06	3.41E-06	lb		
		Mercury	4.65E-05	9.99E-05		1.68E-04	3.14E-04	lb		
		Methanol	3.15E-04	1.95E-04		1.55E-03	2.06E-03	lb		
		Methyl Ethyl Ketone	1.32E-06	1.29E-06		1.77E-05	2.03E-05	lb		
		Methyl Isobutyl Ketone	4.96E-09	4.86E-09		6.65E-08	7.64E-08	lb		
		Methyl Tert-Butyl Ether	1.88E-05	2.57E-05		1.32E+00	1.32E+00	lb		
		Molybdenum Trioxide	5.99E-07	5.87E-07		8.03E-06	9.22E-06	lb		
		n-Butane				1.96E-01	1.96E-01	lb		
		n-Butyl Alcohol				2.58E-08	2.58E-08	lb		
		n-Pentane				3.75E-01	3.75E-01	lb		
		n-Hexane	3.38E-07	2.07E-06		3.14E-01	3.14E-01	lb		
		n-Heptane				1.74E-01	1.74E-01	lb		
		n-Methyl-2-Pyrrolidone				6.72E-05	6.72E-05	lb		
		n-Octane				1.65E-02	1.65E-02	lb		
		n-Nonane				1.28E-02	1.28E-02	lb		
		n-Decane				1.23E-02	1.23E-02	lb		

		n-undecane				7.00E-03	7.00E-03	lb		
		n-Dodecane				9.24E-03	9.24E-03	lb		
		n-Tridecane				1.10E-02	1.10E-02	lb		
		n-Tetradecane				1.19E-02	1.19E-02	lb		
		n-Pentadecane				1.13E-02	1.13E-02	lb		
		n-Hexadecane				1.07E-02	1.07E-02	lb		
		n-Heptadecane				1.05E-02	1.05E-02	lb		
		n-Octadecane				6.39E-03	6.39E-03	lb		
		n-Nonadecane				7.80E-03	7.80E-03	lb		
		n-Icosane				7.16E-03	7.16E-03	lb		
		n-Henicosane				6.63E-03	6.63E-03	lb		
		n-Docosane				6.46E-03	6.46E-03	lb		
		Naphthalene	1.47E-04	4.13E-04		6.59E-04	1.22E-03	lb		
		Nickel				4.06E-07	4.06E-07	lb		
		Nickel Compounds	5.53E-06	3.18E-05		1.95E-05	5.69E-05	lb		
		Nitrates	2.73E-03	2.68E-03		3.67E-02	4.21E-02	lb		
		o-Xylene				1.41E-03	1.41E-03	lb		
		Oil	5.58E-04	4.16E-03		0.00E+00	4.72E-03	lb		
		p-Cresol				7.83E-07	7.83E-07	lb		
		p-Xylene				1.41E-03	1.41E-03	lb		
		Phenanthrene				9.23E-08	9.23E-08	lb		
		Phenol	1.35E-04	1.00E-03		2.07E-05	1.16E-03	lb		
		Polycyclic Aromatic Compounds	4.98E-08	4.88E-08		6.68E-07	7.66E-07	lb		
		Propylene				1.43E-06	1.43E-06	lb		
		Selenium				6.12E-07	6.12E-07	lb		
		Selenium Compounds				4.94E-06	4.94E-06	lb		
		Sodium Nitrite				6.01E-05	6.01E-05	lb		
		Styrene				1.01E-07	1.01E-07	lb		
		Sulfates	2.68E-04	2.00E-03		0.00E+00	2.27E-03	lb		
		Sulfuric Acid	2.04E-02	1.52E-01		0.00E+00	1.73E-01	lb		
		Tert-Butyl Alcohol				1.76E-05	1.76E-05	lb		
		Tetrachloroethylene				1.07E-06	1.07E-06	lb		
		Toluene	9.15E-04	2.65E-03		6.30E-01	6.33E-01	lb		
		Vanadium				7.08E-08	7.08E-08	lb		
		Xylene (mixed Isomers)	3.84E-06	1.94E-05		6.22E-01	6.22E-01	lb		

		Zinc Compounds	1.32E-01	8.05E-02		6.15E-01	8.27E-01	lb		
		Volatile Organic Compounds (VOC)		5.05E-07		9.08E-02	9.09E-02	lb		
		Total	9.70E-01	1.58E+00		1.28E+01	1.54E+01	lb		
	Solid Waste									
			Mat. P&D	Fuel P&D	Fuel Use	Process	Total	Units		
		Sludge	2.52E+01	1.54E+01		1.17E+02	1.58E+02	lb		
		Solid Waste #1	5.50E+00	4.08E+01			4.63E+01	lb		
		Disposal Off-site, Subtitle D Landfill	7.73E-03	5.78E-03		1.70E-02	3.05E-02	lb		
		Disposal Off-site, Subtitle C Landfill	3.04E-03	2.27E-03		6.68E-03	1.20E-02	lb		
		Disposal On-site, Subtitle D Landfill	1.34E-03	1.00E-03		2.94E-03	5.28E-03	lb		
		Disposal On-site, Subtitle C landfill	3.41E-04	2.55E-04		7.50E-04	1.35E-03	lb		
		Total:	3.08E+01	5.61E+01		1.17E+02	2.04E+02	lb		
Raw Materials Extracted										
	Fossil Fuel		Mat. P&D	Fuel P&D	Fuel Use	Process	Total	Units		
		Coal	1.08E+05	8.06E+05			9.14E+05	Btu		
		Crude Oil	1.19E+07	4.73E+06		5.67E+07	7.33E+07	Btu		
		Natural Gas	3.54E+04	2.64E+05			3.00E+05	Btu		
	Non-Fossil Fuel									
		Uranium	4.72E-05	6.69E-02			6.69E-02	lb		
		Wood	3.79E-01	3.61E+00			3.99E+00	lb		
	Water Consumption									
			Mat. P&D	Fuel P&D	Fuel Use	Process	Total	Units		
		Public Supply					0.00E+00	gal		
		River/Canal					0.00E+00	gal		
		Sea					0.00E+00	gal		
		Unspecified				2.27E+02	2.27E+02	gal		
		Well					0.00E+00	gal		
		Total:				2.27E+02	2.27E+02	gal		
Land Use										
			Mat. P&D	Fuel P&D	Fuel Use	Process	Total	Units		
		Unknown						acres		

Appendix B
LCA and LCI Software Tools

Tool	Vendor	URL
BEES 3.0	NIST Building and Fire Research Laboratory	http://www.bfrl.nist.gov/oae/software/bees.html
Boustead Model 5.0	Boustead Consulting	http://www.boustead-consulting.co.uk/products.htm
CMLCA 4.2	Centre of Environmental Science	http://www.leidenuniv.nl/cml/ssp/software/cmlca/index.html
Dubo-Calc	Netherlands Ministry of Transport, Public Works and Water Management	http://www.rws.nl/rws/bwd/home/www/cgi-bin/index.cgi?site=1&doc=1785
Ecoinvent 1.2	Swiss Centre for Life Cycle Inventories	http://www.ecoinvent.ch
Eco-Quantum	IVAM	http://www.ivam.uva.nl/uk/producten/product7.htm
EDIP PC-Tool	Danish LCA Center	http://www.lca-center.dk
eiolca.net	Carnegie Mellon University	http://www.eiolca.net
Environmental Impact Indicator	ATHENA™ Sustainable Materials Institute	http://www.athenaSMI.ca
EPS 2000 Design System	Assess Ecostrategy Scandinavia AB	http://www.assess.se/
GaBi 4	PE Europe GmbH and IKP University of Stuttgart	http://www.gabi-software.com/software.html
GEMIS	Öko-Institut	http://www.oeko.de/service/gemis/en/index.htm
GREET 1.7	DOE's Office of Transportation	http://www.transportation.anl.gov/software/GREET/index.html
IDEMAT 2005	Delft University of Technology	http://www.io.tudelft.nl/research/dfs/idemat/index.htm
KCL-ECO 4.0	KCL	http://www1.kcl.fi/eco/softw.html
LCAIT 4.1	CIT Ekologik	http://www.lcait.com/01_1.html
LCAPIX v1.1	KM Limited	http://www.kmlmtd.com/pas/index.html
MIET 3.0	Centre of Environmental Science	http://www.leidenuniv.nl/cml/ssp/software/miet/index.html
REGIS	Sinum AG	http://www.sinum.com/htdocs/e_software_regis.shtml
SimaPro 6.0	PRé Consultants	http://www.pre.nl/simapro.html
SPINE@CPM	Chalmers	http://www.globalspine.com
SPOLD	The Society for Promotion of Life-Cycle Assessment	http://lca-net.com/spold/
TEAM™ 4.0	Ecobalance	http://www.ecobalance.com/uk_lcatool.php
Umberto	ifu Hamburg GmbH	http://www.ifu.com/en/products/umberto
US LCI Data	National Renewable Energy Lab	http://www.nrel.gov/lci

BEES 3.0. Created by the National Institute for Standards and Technology (NIST) Building and Fire Research Laboratory, the BEES (Building for Environmental and Economic Sustainability) software can be used for balancing the environmental and economic performance of building products. Version 3.0 of the Windows™-based decision support software, aimed at designers, builders, and product

manufacturers, includes actual environmental and economic performance data for 200 building products. BEES 3.0 can be downloaded free of charge from the NIST website.

Boustead Model 5.0. Created by Boustead Consulting, the Boustead Model is an extensive database in which data such as fuels and energy use, raw materials requirements, and solid, liquid, and gaseous emissions are stored. It also includes software which enables the user to manipulate data in the database and to select a suitable data presentation method from a host of options.

CMLCA 4.2. Created by the Centre of Environmental Science (CML) at Leiden University, Chain Management by Life Cycle Assessment (CMLCA) is a software tool that is intended to support the technical steps of the LCA procedure. The program can be downloaded from the CML website.

Dubo-Calc. The Netherlands Ministry of Transport, Public Works, and Water Management has created a database containing LCI data of construction materials which are used in civil works. Data included are secondary data, derived from other databases, brought together in a set to use with their software for designers.

Ecoinvent Database v1.2. The ecoinvent data v1.2 comprises more than 2700 datasets with global/European/Swiss coverage. About 1000 elementary flows are reported for each dataset, including emissions to air, water, and soil, mineral and fossil resources, and land use. Several actual and widespread impact assessment methods, namely the cumulative energy demand, climate change, CML 2001, Eco-indicator 99, the ecological scarcity method 1997, EDIP 1997, EPS 2000, and Impact 2002+ are implemented. The ecoinvent data are available through EMIS, GaBi, Regis, SimaPro, and Umberto and are importable into CMLCA, KCL-eco, and TEAM.

Eco-Quantum. Eco-Quantum is a calculating tool on the basis of LCA which serves actors in the building sector with quantitative information on the environmental impact of buildings as a whole. The added value of Eco-Quantum in this context is the database with composition data of about 1000 building components. Eco-Quantum is available only in Dutch.

EDIP PC-Tool. Developed for the Danish EPA, the EDIP PC-Tool is a user friendly Windows application and database that supports the LCA process carried out according to the EDIP method. To carry out an LCA, detailed information on all the processes and materials included in the life cycle of the product is needed. Therefore, the tool has been equipped with a relational database, close in structure to the internationally recognized SPOLD format.

eiolca.net. Created by the Green Design Institute of Carnegie Mellon, this web site allows users to estimate the overall environmental impacts from producing a certain dollar amount of a commodity or service in the United States. The database first was made publicly available in 1999; since then two major and several minor updates have been conducted. The web-based model provides rough guidance on the relative impacts of different types of products, materials, services, or industries with respect to resource use and emissions. The latest version is based on the 1997 industry benchmark input-output accounts compiled by the Bureau of Economic Analysis of the U.S. Department of Commerce. It incorporates emissions and resource use factors estimated for all 491 sectors of the U.S economy, using publicly available electricity and fuel consumption data compiled by the U.S. Census Bureau, the U.S. Departments of Energy and Transportation, and environmental databases created by the U.S. EPA.

Environmental Impact Indicator. Developed by the Athena Institute, the Estimator was prepared for architects, engineers, and researchers to get LCA answers about conceptual designs of new buildings or renovations to existing buildings. The Estimator assesses the environmental implications of industrial, institutional, office, or both multi-unit and single-family residential designs. The Estimator incorporates

the Institute's inventory databases that cover more than 90 structural and envelope materials. Released in 2002, it simulates over 1,000 different assembly combinations and is capable of modeling 95 percent of the building stock in North America. Athena has also developed databases for energy use and related air emissions for on-site construction of building assemblies; maintenance, repair and replacement effects though the operating life; and, demolition and disposal.

EPS 2000 Design System. Created by Assess Ecostrategy Scandinavia AB, EPS (Environmental Priority Strategies) is a life cycle impact assessment software for sustainable product development. A demo version can be ordered from the website.

GaBi 4 Software System and Database. GaBi is supported jointly by PE Europe GmbH and IKP University of Stuttgart. Different versions are available from educational to professional use of Life Cycle Analysis to evaluate life cycle environmental, cost, and social profiles of products, processes and technologies. GaBi offers databases with worldwide coverage as well as Ecoinvent data. A demo version is available for download.

GEMIS (Global Emission Model for Integrated Systems). The Öko-Institut's GEMIS is a life cycle analysis program and database for energy, material, and transport systems. The GEMIS database offers information on fossil fuels, renewables, processes for electricity and heat, raw materials, and transports. The GEMIS database can be downloaded for free from the website.

GREET 1.7. The U.S. Department of Energy's Office of Transportation Technologies fuel-cycle model called GREET (Greenhouse gases, Regulated Emissions, and Energy use in Transportation) allows researchers to evaluate various engine and fuel combinations on a consistent fuel-cycle basis.

IDEMAT 2005. Created by Delft University of Technology, IDEMAT is a tool for material selections in the design process. It provides a database with technical information about materials, processes and components and allows the user to compare information. A demo version can be downloaded from the DTU website.

KCL-ECO 4.0. KCL-ECO can be used to apply LCA to complicated systems with many modules and flows. It includes allocation, impact assessment (characterization, normalization, and weighting), and graphing features. A demo version can be downloaded from the KCL website.

LCAIT 4.1. Offered by CIT Ekologik since 1992, LCAit has been used for the environmental assessment of products and processes. It includes an impact assessment database, including characterization factors and weighting factors. A demo version can be downloaded from the CIT website.

LCAPIX. Offered by KM Limited, the LCAPIX v1.1 software combines LCA and Activity Based Costing (ABC) to help businesses assure environmental compliance while assuring sustained profitability. It allows for a quantitative measurement which can indicate the potential burden of any product. A licensing fee is required, but a demo version can be downloaded from the KM Ltd. website.

MIET 3.0. – Missing Inventory Estimation Tool. Created by the Centre of Environmental Science (CML), MIET is a Microsoft Excel spreadsheet that enables LCA practitioners to estimate LCI of missing flows that were truncated. MIET is based on the most up-to-date U.S. input-output table and environmental data. MIET covers about 1,200 different environmental interventions including air, water, industrial and agricultural soil emissions, and resource use by various industrial sectors. MIET can be downloaded for free from the CML website after filling out a short questionnaire.

REGIS. Developed by Sinum AG, REGIS is a software tool for creating corporate ecobalances and improving corporate environmental performance according to ISO14031. A demo version can be downloaded from the Sinum website.

SimaPro 6.0. Created by PRé Consultants, SimaPro is a professional LCA software tool that contains several impact assessment methods and several inventory databases, which can be edited and expanded without limitation. It can compare and analyze complex products with complex life cycles. A demo version can be downloaded from the web site link provided above.

SPINE@CPM. Maintained by IMI, Industrial Environmental Informatics at Chalmers University of Technology, LCI@CPM is a web portal for LCI information. The portal provides the possibility to: search for specific LCI-data in the database; purchase LCI-data sets; and convert SPINE data sets into ISO/TS 14048 automatically. The database contains more than 500 data sets. SPINE@CPM is the ISO/TS 14048 version of the Swedish national database. Some of the data sets in the database are reported as full flow-charts where each included process or transport is separately stored in the database. The data published in LCI@CPM are reviewed in order to ensure that the quality requirements according to ISO/TS 14048 have been fulfilled.

SPOLD Data Exchange Software. The Society for Promotion of Life Cycle Development, a now defunct group, lives on in memory through this software that can be used to create, edit, import, and export data in the SPOLD '99 format. It can be downloaded from the 2.-0 LCA consultants website.

TEAM™ 4.0. Offered by Pricewaterhouse Coopers Ecobilan Group (also known as Ecobalance), TEAM™ 3.0 is a professional tool for evaluating the life cycle environmental and cost profiles of products and technologies. It contains comprehensive database of over 600 modules with worldwide coverage. An online demo is available from the website.

Umberto. Created by the Institute for Environmental Informatics (ifeu) in Hamburg, Germany, Umberto serves to visualize material and energy flow systems. Data are taken from external information systems or are newly modeled and calculated.

US LCI Data. In May 2001, NREL and its partners created the U.S. Life-Cycle Inventory (LCI) Database to provide support to public, private, and non-profit sector efforts in developing product life cycle assessments and environmentally-oriented decision support systems and tools. The objective of the U.S. LCI Database Project is to provide LCI data for commonly used materials, products and processes following a single data development protocol consistent with international standards. Since the goal is to make the creation of LCIs easier, rather than to carry out full product LCIs, database modules provide data on many of the processes needed by others for conducting LCIs. However, the modules do not contain data characterizing the full life cycles of specific products. The data protocol is based on ISO 14048 and is compatible with the EcoSpold format. The LCI data are available in several formats: a streamlined spreadsheet, an EcoSpold format spreadsheet, an EcoSpold XML file, and a detailed spreadsheet with all the calculation details.

Glossary

Accidental Emission	An unintended environmental release.
Allocation	Partitioning the input or output flows of a unit process to the product of interest.
Attributional LCA	An LCA that accounts for flows/impacts of pollutants, resources, and exchanges among processes within a chosen temporal window.
Background Data	The background data include energy and materials that are delivered to the foreground system as aggregated data sets in which individual plants and operations are not identified.
Brines (oilfield)	Wastewater produced along with crude oil and natural gas from oilfield operations.
By-Products	an incidental product deriving from a manufacturing process or chemical reaction, and not the primary product or service being produced. A by-product can be useful and marketable, or it can have negative ecological consequences.
Characterization	Characterization is the second step of an impact assessment and characterizes the magnitude of the potential impacts of each inventory flow to its corresponding environmental impact.
Characterization Factor	Factor derived from a characterization model which is applied to convert the assigned LCI results to the common unit of the category indicator.
Classification	Classification if the first step of an impact assessment and is the process of assigning inventory outputs into specific environmental impact categories.
Composite Data	Data from multiple facilities performing the same operation that have been combined or averaged in some manner.
Consequential LCA	An LCA that attempts to account for flows/impacts that are caused beyond the immediate system in response to a change to the system.
Co-Product	A product produced together with another product.
Environmental Aspects	Elements of a business' products, actions, or activities that may interact with the environment.
Environmental Loadings	Releases of pollutants to the environment, such as atmospheric and waterborne emissions and solid wastes.

Equivalency Factor	An indicator of the potential of each chemical to impact the given environmental impact category in comparison to the reference chemical used.
Equivalent Usage Ratio	A basis for comparing two or more products that fulfill the same function. For example, comparing two containers based on a set volume of beverage to be delivered to the customer.
Facility-Specific Data	Data from a particular operation within a given facility that are not combined in any way.
Foreground Data	Data from the foreground system that is the system of primary concern to the analyst.
Fuel P&D	Activities involved in the processing and delivery of fuel used to run a process**;** also called Precombustion Energy.
Functional Unit	The unit of comparison that assures that the products being compared provide an equivalent level of function or service.
Green Technology	A technology that offers a more environmentally benign approach compared to an existing technology.
Impact Assessment	The assessment of the environmental consequences of energy and natural resource consumption and waste releases associated with an actual or proposed action.
Impact Categories	Classifications of human health and environmental effects caused by a product throughout its life cycle.
Impact Indicators	Impact indicators measure the potential for an impact to occur rather than directly quantifying the actual impact.
Industrial System	A collection of operations that together perform some defined function.
Inventory Analysis	The identification and quantification of energy, resource usage, and environmental emissions for a particular product, process, or activity.
Interpretation	The evaluation of the results of the inventory analysis and impact assessment to reduce environmental releases and resource use with a clear understanding of the uncertainty and the assumptions used to generate the results.
Life Cycle Assessment	A cradle-to-grave approach for assessing industrial systems that evaluates all stages of a product's life. It provides a comprehensive view of the environmental aspects of the product or process.
Material P&D	Activities involved in the processing and delivery of materials to a process.

Normalization	Normalization is a technique for changing impact indicator values with differing units into a common, unitless format by dividing the value(s) by a selected reference quantity. This process increases the comparability of data among various impact categories.
Precombustion Energy	The extraction, transportation, and processing of fuels used for power generation, including adjusting for inefficiencies in power generation and transmission losses.
Product Life Cycle	The life cycle of a product system begins with the acquisition of raw materials and includes bulk material processing, engineered materials production, manufacture and assembly, use, retirement, and disposal of residuals produced in each stage.
Routine emissions	Those releases that normally occur from a process, as opposed to accidental releases that proceed from abnormal process conditions.
Sensitivity Analysis	A systematic evaluation process for describing the effect of variations of inputs to a system on the output.
Specific data	Data that are characteristic of a particular subsystem, or process.
Stressors	A set of conditions that may lead to an environmental impact. For example, an increase in greenhouse gases may lead to global warming.
System Flow Diagram	A depiction of the inputs and outputs of a system and how they are connected.
Weighting	The act of assigning subjective, value-based weighting factors to the different impact categories based on their perceived importance or relevance.

UNEP

Why Take A Life Cycle Approach?

Life Cycle Initiative

SETAC

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Contents

Highlights

The following highlights illustrate a life cycle approach in practice.

Foreword

Fritz Balkau
Head, Production & Consumption Branch
UNEP Division of Technology, Industry and Economics

In 2002, the United Nations Environment Programme, (UNEP), joined forces with the Society of Environmental Toxicology and Chemistry (SETAC) to launch the Life Cycle Initiative, an international partnership to put life cycle thinking into practice. The initiative is a response to the call from governments for a life cycle economy in the Malmö Declaration (2000), and it contributes to the 10-year framework of programmes to promote sustainable consumption and production patterns, as requested at the World Summit on Sustainable Development in Johannesburg (2002). The first action of the Life Cycle Initiative was to draft definition studies to determine a road map for the next years on how to develop and disseminate practical tools for evaluating the opportunities, risks, and trade-offs associated with products and services over their entire life cycle to achieve sustainable development. A second task was to prepare the present brochure to raise awareness among executives and managers in industry, governments, and civil society on the advantages of taking a life cycle approach for making sustainable decisions. Spreading the idea of life cycle thinking is an important part of UNEP's promotion of an integrated approach to sustainable consumption and production. The current form of life cycle analysis can tell us what the materials and energy flow is and where the impacts occur. To make decisions in a life cycle perspective, however, we need to move to life cycle management. Therefore, we need to include a key player analysis at important stages in the chain, a systematic study of policy options, and a management model for addressing impacts in a holistic way. That means we still have much to do, and the Life Cycle Initiative has an important future ahead of it. We in the production and consumption branch of UNEP hope that this brochure, as well as other activities of the initiative, will help to raise awareness of life cycle approaches around the world and assist in their effective implementation.

James Fava
Managing Director,
Five Winds
International
www.fivewinds.com

Much has occurred in the area of life cycle since 1989 when a small group representing the United States Environmental Protection Agency (US EPA), Battelle, Procter & Gamble and myself met in Cincinnati, Ohio, USA to discuss the possibility of a workshop on what was to become "life cycle assessment." Since that workshop hundreds of organizations have completed LCAs of product systems. LCA has become a leading tool within businesses and government to understand and manage risks or opportunities associated with products over their entire life cycle (that is, from material acquisition, production, use and eventual disposal). With the leadership of SETAC, UNEP, and International Organization for Standardization (ISO), civil society has come a long way in understanding and using life cycle approaches. Yet there is still much to do.

Under the current partnership among SETAC, UNEP, and all of the sponsors of the UNEP/SETAC Life Cycle Initiative, we have had several successful years laying the foundation to move life cycle thinking and approaches to another level. The International Life Cycle Panel – highest body of the Life Cycle Initiative – approved in January 2003 the desire to prepare additional information materials on the value of life cycle approaches for a broader audience. This Why Take a Life Cycle Approach brochure is a small step to build greater understanding of life cycle approaches and their value towards creating more sustainable forms of design, production, and consumption. We illustrate through clear examples how life cycle thinking and other approaches have been or can be used to improve the way we think about problem solving and use the information available to us.

I would like to thank all of the International Life Cycle Panel members and the Initiative's Executive Committee for their extremely valuable comments and suggestions. Special thanks goes to Jennifer Hall (Five Winds International) and Guido Sonnemann (UNEP/SETAC Life Cycle Initiative Secretariat) for their tireless energies and efforts to make this brochure a reality.

"Consumers are increasingly interested in the world behind the product they buy. Life cycle thinking implies that everyone in the whole chain of a product's life cycle, from cradle to grave, has a responsibility and a role to play, taking into account all the relevant external effects. The impacts of all life cycle stages [materials and manufacturing, use by the customer, disposal and handling at end of use] need to be considered comprehensively when taking informed decisions on production and consumption patterns, policies and management strategies"

Klaus Toepfer
Executive Director, UNEP

Opportunities in our Community our Economy, & our Environment

Today, there is opportunity for each of us to make well-informed choices – both as individuals and for the companies and governments where we work. A life cycle approach is one part of finding and attaining these opportunities.

There are opportunities for different nationalities, cultures, professional disciplines, governments, businesses and Non Governmental Organisations, (NGOs) to become partners, working together to develop in a sustainable way. We have greater ability to cooperate, to be informed about the source of our environmental, social, and economical challenges, and to engage people on a global and local scale to address these challenges (highlight a).

These opportunities are enhanced as:

- people from across the globe use new communication technologies to connect and interact with each other
- we share knowledge amongst countries and trade services, materials, and products such as foods and medicines
- we read detailed information about the services and products we select from our own community or from around the world
- and as businesses, governments and other organizations use information to understand how to act as responsible global citizens – then use their influence to bring more value to their communities.

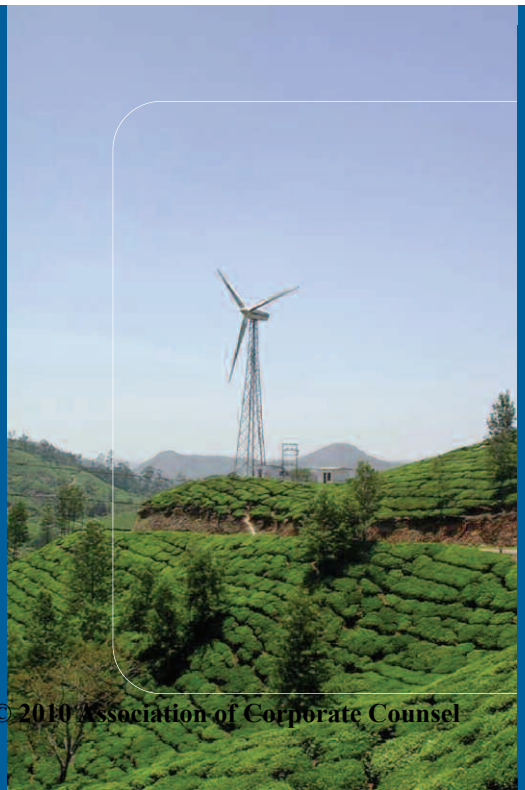
The purpose of this brochure is to introduce a life cycle approach as one means to help us recognize opportunities, balance opportunities with risks and make choices that contribute value to our economies, our natural environments, and our communities.

Reading this brochure will help you understand what a life cycle approach means and how individuals, businesses, and governments take that approach. It also illustrates the benefits and suggests where you can find out more!

"... the root causes of global environmental degradation are embedded in social and economic problems such as pervasive poverty, unsustainable production and consumption patterns, inequity in distribution of wealth, and the debt burden... success in combating environmental degradation is dependent on the full participation of all actors in society, an aware and educated population, respect for ethical and spiritual values and cultural diversity, and protection of indigenous knowledge"

Ministers of the Environment, The First Global Ministerial Environment Forum, Malmö, Sweden, May 2000

Life cycle approaches help us to find ways to generate the energy we need without depleting the source of that energy and without releasing greenhouse gases that contribute to climate change.



a) Partnering to Develop in a Sustainable Way

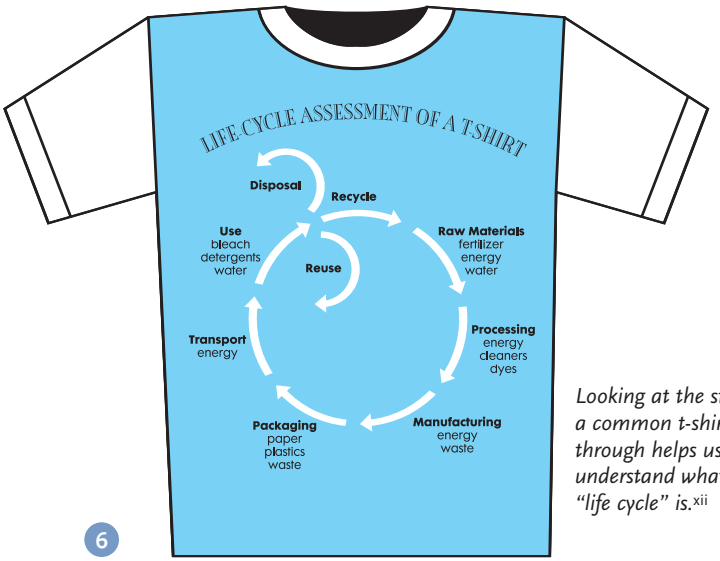
"Somewhere in northern Europe a group of environmental experts are meeting to discuss how to solve the problems related to [the chemicals used] in televisions [to prevent accidental burning]. At the same time access to clean drinking water is being discussed at a meeting of the European Commission in Brussels, and a little later in the day a group of diplomats will gather in New York to prepare for the next global conference on the environment. In Poland a new water treatment plant will be opened on the same day so that the Baltic Sea will become a little less polluted, and at the Danish Environmental Protection Agency (Danish EPA) we are receiving a visit from our colleagues from Egypt."

"These are all examples of activities that are made possible because of a global network of partners involved in caring for our common heritage – the Environment of the Earth. In some way or other the Danish EPA will be involved, simply because we can only solve environmental problems through international cooperation in which we commit each other to initiatives, and where different countries can share experience, knowledge, and technology".

Danish Environmental Protection Agency, excerpt from Working for a Cleaner World.

What is a Life Cycle Approach?

A system, or life cycle can begin with extracting raw materials from the ground and generating energy. Materials and energy are then part of manufacturing, transportation, use (wearing and washing the t-shirt, for instance), and eventually recycling, reuse, or disposal. A life cycle approach means we recognize how our choices influence what happens at each of these points so we can balance trade-offs and positively impact the economy, the environment, and society. A life cycle approach is a way of thinking which helps us recognize how our selections – such as buying electricity or a new t-shirt – are one part of a whole system of events.



Looking at the stages a common t-shirt goes through helps us understand what a "life cycle" is.[xii]

"The global plastics industry has been a long-time advocate of life cycle thinking and eco-efficiency as methods to demonstrate and optimize the resource, efficiency, functionality, and performance characteristics of plastics throughout the full value chain of its products, while minimizing emissions and environmental impacts of plastics on society. PlasticsEurope (formerly APME) and the American Plastics Council provide polymer life cycle inventory databases to help users of plastics – manufacturers, academia, governments, NGOs, and the public – better understand the contributions plastic products make towards sustainable development, while creating a lighter footprint on the environment"

Mike Levy, American Plastics Council, life cycle coordinator and Executive Director, Polystyrene Packaging Council & EPS Resin Suppliers Council

A life cycle approach identifies both opportunities and risks of a product or technology, all the way from raw materials to disposal. To do this there is a continuum of life cycle approaches from qualitative (life cycle thinking) to comprehensive quantitative approaches (life cycle assessment studies). People, companies and governments use these various life cycle approaches in anything from day to day shopping, selecting office supplies for the workplace, engineering a new product design, or developing a new government policy.

Food grown in one region is often transported and sold all over the world. Agricultural practices are an important part of the life cycle of foods we eat, but so is transportation. Foods transported long distances by airplane, ship or rail to markets can have a larger impact on the environment than foods which are eaten locally, because of the energy and emissions from each different type of transportation.

"Human needs should be met by products and services that are aimed at specific 'functions' such as food, shelter and mobility, and that are provided through optimized consumption and production systems that do not exceed the capacity of the ecosystem."

Life Cycle Initiative Brochure, UNEP SETAC 'International Partnership', 2003

A Life Cycle Approach Promotes ...

... Awareness that our selections are not isolated, but influence a larger system. Buying office paper is a good example. If you knew that it takes 24 trees to create 50,000 sheets of office paper and 2.3 cubic meters of landfill space to dispose of it, you might choose paper made from recycled material and elect to support paper producers that source from sustainably managed forests.

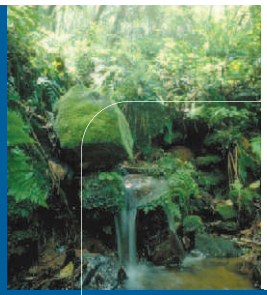
... Making choices for the longer term and considering all environmental and social issues associated with those. Life cycle thinking helps us avoid short term decisions that lead to environmental degradation – such as over-fishing or polluting our air with mercury.

... Improving entire systems, not single parts of systems, by avoiding decisions that fix one environmental problem but cause another unexpected or costly environmental problem (like mitigating air pollution yet increasing water pollution, highlight b). Life cycle thinking helps avoid shifting problems from one life cycle stage to another, from one geographic region to another and from one environmental medium (air, water or soil) to another.

... Informed selections, but not necessarily 'right' or 'wrong' ones. Life cycle thinking simply helps us put our decisions in context with facts from all parts of the system or life cycle. It means we look for unintentional impacts of our actions (such as damaging a natural eco-system or inadvertently supporting unfair labour conditions and wages) and take some action to prevent those impacts (such as purchasing office paper from sustainably managed forests or coffee certified "fair trade"). For instance, if the shop around the block from your office sells coffee grown by workers who receive a fair wage on the world market, cultivated without pesticides that harm people planting or harvesting the beans and from a plantation that did not cause an endangered forests to be chopped down, you might choose to purchase your daily cup from that shop.

"Corporate membership of the International Council on Mining and Metals (ICMM) - comprised of 15 of the world's largest mining and metal producing companies - has signed an undertaking to recognise existing World Heritage properties as 'no-go' areas"

International Council on Mining & Metals, August 2003 news release



Office paper and cardboard packaging can be made of wood from sustainably managed forests or from recycled paper.
Beans for your office's coffee machine can be grown organically and certified "fair trade". This means farmers were paid a minimum, internationally established price per kilogram, among other things.

The fishing industry is one to recognize the importance of long term planning and decisions, a key part of life cycle thinking. Planning for the long term ensures today's decisions support future activities, (photo by Telfer Wegg).
When life cycle thinking informs our activities, such as electricity generation, we may avoid fixing one environmental problem while unknowingly causing another (switching from nuclear power generation to coal fired generation prevents nuclear waste but releases mercury which damages ecosystems and human populations).

From Concept Into Practice

More and more people are basing their decisions on life cycle information, in effort to gain the most from their actions without unintentionally jeopardizing their ability to thrive in the future.

Life cycle thinking applies to the daily decisions we make at our homes and workplaces, decisions about creating services and how we develop our communities. Citizens, businesses, and governments are finding ways to promote life cycle thinking and balance the impacts of their choices.

Thinking about how our industries and homes use water and what we release into our water systems are key life cycle considerations. With life cycle information, we can design industrial processes and use raw materials in ways that preserve water quality and access to clean water around the world. Amapa, Brazil. Photo by Pratginestos, ©WWF-Canon.

A life cycle approach to community planning and development can lead to fewer environmental impacts from materials used, construction practices, and waste management, as well as the energy and water used by people living and working in the community. Photo: Sydney Olympic Village

b) Avoid Shifting Problems from One Part of the Environment to Another[i]

MTBE (Methyl Tertiary Butyl Ether) is added to gasoline to increase octane levels and enhance combustion, which in turn reduces polluting emissions. MTBE in gasoline can reduce ozone precursors by 15%, benzene emissions by 50%, and CO emissions by 11%. While MTBE helps mitigate air pollution, the MTBE itself may be toxic if not combusted fully. Levels of MTBE in the environment are now measured when MTBE is suspected to have evaporated from gasoline or leaked from storage tanks, lines and fueling stations. Of most concern is the MTBE found in lakes, reservoirs, and groundwater for potable water supplies. In some cases, MTBE concentrations already exceed standard indicators for potable water, including "taste and odor" and "human health". While MTBE is not considered highly toxic, there is insufficient information available on its long-term toxicity, including carcinogenicity and reproductive toxicity, to humans, animals and ecosystems. This situation illustrates the drawbacks of not taking a life cycle approach. Focusing on air quality, without thinking of water or land, and on only one stage of the car's life cycle (namely emissions during use) generated unforeseen, adverse effects in other environmental media and life cycle stages. While there is not always an easy choice, it is important to understand potential impacts associated with each choice. In this case, taking a life cycle approach to evaluate MTBE may have alerted decision-makers to potential water contamination problems and allowed us to prevent contamination by producing, transporting and storing MTBE more effectively.

Life Cycle Thinking in Your Daily Decisions

As consumers, we can look for life cycle information about the products and services we buy – do they entail the use of energy, illegal labour conditions, the production of hazardous waste, the destruction of an endangered ecosystem, or the pollution of air and water? We can try to find out if the businesses we regularly buy from have initiatives to address these issues and look for ways to support that work. For some products and services, eco-labels and other types of environmental and social information demonstrate the awareness of the businesses we buy from (highlights c & d). We can also look for information that tells us how we should use, care for, recycle or discard products effectively (highlight e). All of this information is becoming increasingly available for products, and services ranging from foods such as fish and other meats to washing powder, hotels, cars, paper products and computers, among many others. Sometimes a simple label can tell us whether the mobile telephone we are buying or the golf course we're using has fewer environmental impacts than certain alternatives.

"The Minister of Norway emphasized the relevance of promoting "eco-efficient" consumption by discussing the "importance of enabling consumers to make informed product choices through life cycle analysis, eco-labeling initiatives and other information tools,"

Mr. Borge Brende, Minister of Norway, Ministerial Meeting of UNEP's Governing Council, February 2003.

c) Life Cycle Considerations in Thai Green Labels

Thailand's Ministry of Industry, the Thailand Business Council for Sustainable Development, the Thai Industrial Standards Institute, and the Thailand Environmental Institute wanted to encourage businesses to improve the environmental quality of their products and services by stimulating consumer demand for such products. In October 1993, the group initiated the Green Label Scheme – a scheme to establish product criteria and certify products with less impact on the environment, compared to other products serving the same function. The product criteria are based on the significant impacts a product may have on the environment during its life cycle (referred to as life cycle consideration), as well as how easily businesses could meet criteria with reasonable process changes or improvements.[ii]

d) Environmental Improvement & Growing Consumption

UNEP's global status report on sustainable consumption describes how improvements in efficiency – such as reducing the amount of waste or energy per product or service generated – are being offset by increased consumption of these products and services. For instance, the benefits of low-energy light bulbs are lost if we leave the lights on for longer periods and energy efficient appliances bring less benefit if we buy larger appliances than we need. Improving efficiency and reducing consumption should go hand-in-hand to ensure we achieve real improvements for our environment and our communities.

"Consumers will give preference to products and services that they understand will make a smaller footprint. Consumer information needs to be as simple as possible consistent with maintaining its integrity; be reliable over reasonable time frames; and seem sensible to consumers when interrogated more deeply"
Louise Sylvan, President, Consumers International.

Hanging clean laundry out to dry can save energy. Moreover, clothes can be washed effectively in a manner that does not waste electricity, water, or soap.

Products with certain environmental performance may apply for Eco-labels – shown here are Thailand's Green Label, Australia's Environmental Choice Logo, and the Marine Stewardship Council's label for fish products.

e) Educating People on Environmental Impacts of Consumption and Use [iii]

Several major manufacturers of laundry soap studied the life cycle of a typical laundry washing powder. They examined how different ways of producing the powder, packaging it, transporting it, and using it impact our environment. They found that while washing powder does contribute to water pollution, people could use the washing powder in ways that prevent the amount of pollution generated and reduce the need for high water temperatures (thus, energy). Knowing this, these companies created television advertisements and information brochures informing people about properly using washing powders – promoting more sustainable consumption. If the education campaign is effective, water pollution is reduced, energy use falls, and customers are happier because using the proper amount also means clothing is cleaned more effectively. In this way, the companies provide their customers with good service and an effective product.

Life Cycle Thinking in Government Policy

When governments design policy, negotiate voluntary agreements with industry, decide where to invest resources, commission new office buildings, or even purchase paper for offices, life cycle thinking can apply. Measuring potential life cycle impacts of decisions can help governments to:

- Inform government programs (highlights f & l) and ***help prioritise*** these programs (highlight g), based on life cycle information.
- ***Make policies more consistent*** among consumers, producers, material suppliers, retailers, and waste managers and also among different policy instruments (such as harmonising regulations, voluntary agreements, taxes, and subsidies).
- Purchase products and services which are "environmentally preferable", ***reduce the impact*** government operations have on the environment (highlight j & l) and ***support regional and global markets*** for "preferable" products and services.
- Promote pricing products and services to ***accurately reflect the costs*** of environmental degradation, health problems, erosion of social welfare, and impacts at other life cycle stages. Such "price signals" can send messages to consumers and provide incentives for businesses to continuously improve the environmental and social performance of products or services, across each stage of the life cycle.[iv]
- Introduce take-back systems to establish a recycling-based economy according to the hierarchy *reduce*, *reuse* and *recycle*.

f) Life Cycle Approach in French Recycling Policy

ADEME, France's Environment and Energy Management Agency, gathered results from life cycle studies that had been conducted on 11 different products and types of packaging, such as paper, aluminum, and plastic packaging. ADEME compared the environmental impacts from recycling the product or packaging with impacts from incinerating it, landfilling it, or otherwise disposing of it. For example, ADEME's comparison showed that recycling plastic is environmentally beneficial if the recycled plastic is used in a product in place of virgin plastic. However, if the recycled plastic is used in place of wood, it would have been more environmentally beneficial to incinerate that plastic and recover the energy from the incinerator (i.e., recycling is not favourable). The French government has used this life cycle information to inform their laws on recycling, waste prevention, and responsible "end-of-life" management for products and packaging. In France, it may soon "... become the responsibility of producers, importers and distributors of products (and materials in those products) to manage or contribute to eliminating waste from those products..." (translated from ART L541-10 du Code de l'Environnement).

The use of pesticides can help crops grow, but it also poisons 3.5 to 5 million people around the world each year when pesticides infiltrate our air and water, causing long-term damage that is costly to reverse.

g) Life Cycle Approach to Developing Policy for Pesticides in Costa Rica

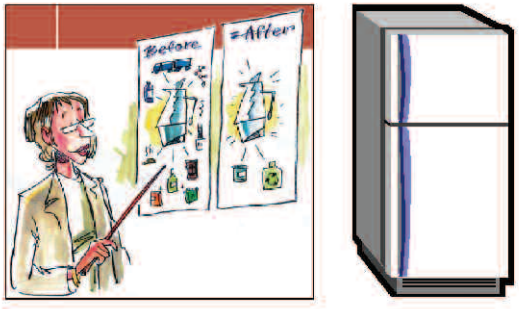
For several years, Costa Ricans have expressed concerns about the damage pesticides may be causing to their health and the environment. National and international NGOs voiced many concerns about pesticides used to grow bananas, strawberries, ferns, and flowers, which were echoed by some regulatory agencies. These concerns were based on perceptions and lacked scientific background, so the Costa Rican Controller's office carried out a project in 2002 using a life cycle approach to understand pesticide use and its consequences on health and the environment in Costa Rica. Twenty-five of the active ingredients most used in pesticides in Costa Rica in 1998 were analyzed, and several types of exposure to these ingredients (to health and environment) were considered. In the end the project found that five of the active ingredients were responsible for roughly 95% of the impact on human health, while three of the active ingredients were accountable for 90% of the impacts on the environment. The Controller's Office understood that these results were only a first "screen" of how these active ingredients affect human health and the environment in Costa Rica; however, the Office was still able to use this information to advise other regulatory agencies on these active ingredients (Ministry of Agriculture, Ministry of Environment, among others). This life cycle approach in policy making was welcomed and was incorporated in a collaborative and relatively inexpensive manner. It is hoped that centers of higher education, regulatory offices, and producer's associations in Costa Rica will incorporate life cycle thinking to inform future decisions.

"... It is time to leave behind this piecemeal approach to environment and to pursue a broader more holistic view of sustainable development through a life cycle approach in our policy making..."

Federico Malavassi, Vice-President of Costa Rica's Congress, opposing a proposed Constitutional Amendment on Environmental Matters, May 2002

Life Cycle Thinking in Business

Businesses design and manufacture the refrigerators, carpeting, soap, and other products we purchase. To do this, a business and its employees in design, sales, and finance make many choices to balance customer satisfaction, quality, innovation, safety, costs, and more. Thinking in terms of the life cycle, businesses recognise that each choice sets the stage for not only how the product will look and function, but also for how it will impact the environment and the community as it is manufactured, used, disposed, or re-used and recycled. For example, washing machines, refrigerators, and other appliances can be made from recycled materials, be free of harmful substances, use minimal water and energy, and be designed to have a long life. Each product characteristic is determined when the product is designed and will impact the environment differently.



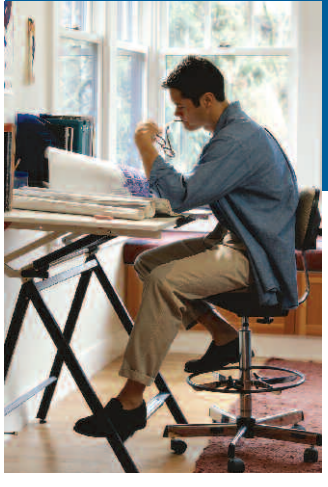
Products can be designed so they will have less environmental impact when they are manufactured, used, and discarded (Danish EPA). Today, refrigerators are made without CFC refrigerants that harm the ozone layer, and some models are also designed to use half as much energy as they did 10 years ago.[v]

To make decisions during product design, businesses research where the raw materials might come from, which manufacturing processes may be needed, who will use the product, what type of maintenance and cleaning might be required, what types of waste will be created, and where the product will go when it is discarded. To find this out, designers conduct life cycle studies and measure the potential impacts of various options (highlight h).

Businesses also request such information from suppliers (highlight i). With life cycle information, companies are able to calculate the full life cycle cost of the goods they purchase. This includes the point-of-purchase price as well as the costs of transporting, storing, installing, cleaning, operating, repairing, and eventually discarding those goods – also known as the 'total cost' of owning that product (highlight k).

h) Environmental Design for Business Reasons

The German carpet producer Donau-Tufting GmbH conducted a life cycle study of their carpet production. Based on what the study found, Donau-Tufting decided to remove heavy-metal colourings and vulcanization chemicals from the carpets they make. The company gained an advantage in the market over its competitors, as the new carpet achieved an additional 25% turnover.



Many life cycle issues can be decided or influenced depending on how a product is designed.

"... The life cycle approach for Rio Tinto makes good business sense; it is seen as a means to assess process improvements in terms of their contribution to sustainable development and it adds value by strengthening the supplier-customer relationship resulting in product differentiation and premiums,"
Bill Adams, Rio Tinto

A product designed with better environmental, social and economic performance across its life cycle may have benefits the company can communicate to its customers (highlights h & i). Some businesses elect to use product declarations or other labels to market environmental and social attributes to their customers.

There are international standards for these business-to-business communications or "environmental product declarations". Each declaration must be based on a life cycle study and tell the business customer about the life cycle environmental impacts of the component or product being purchased. Declarations exist for building and construction products, refrigerators and other appliances, chemicals, train cars, dairy products, and circuit breakers, to name a few (highlight i).

Life cycle thinking that influences product design, strategic planning, procurement, and sales helps businesses:

- ***Enhance their image*** and the value of their brands – businesses can avoid criticism and participate in issues abroad or beyond their direct sphere of influence. Financial indices such as the Dow Jones Sustainability Indexes (DJSI) track and report the financial performance of leading sustainability-driven businesses, worldwide.
- Find ***new ways for marketing*** and sales departments to communicate and interact with customers – some fifty percent of businesses say they are interested in learning about sustainability.[vi] This means a company can promote its products and services by talking about its social and environmental attributes (highlight i).
- Share life cycle information with suppliers, customers, and waste handlers to identify risks and ***opportunities for improvement*** – the risks might relate to the environment, human health, safety, and finance, while opportunities could include growing market share, brand image, effective use of materials, and innovation. Together, businesses can find new ways to improve output while optimising their use of time, money, labour, and material input (highlight e).

i) Providing Life Cycle Information to Business Customers

Market interest in environmental information on products that is credible, unbiased, verifiable, and covers the entire life cycle is growing. To be complete, the information should cover the product life cycle from acquiring raw materials to recycling those materials when the product is no longer in use. Environmental product declarations (EPDs) are meant to provide this type of information in business-to-business communication, promoting "green procurement" in the business and public sectors. Companies use EPDs to communicate their product's environmental performance. ABB, a global manufacturer of power and automation technologies for utility and industry customers, has more than 40 EPDs for a range of its products. EPDs include information about any hazardous substances, disassembly, recovery, and recycling of used products and waste. Quantified life cycle information from an EPD is also a necessary input for many ABB customers working to modify and improve the environmental performance of their products and services through eco-design and innovation. Find out more about EPDs at http://www.environdec.com.

ABB studies the life cycle of certain products – including this motor – from production of raw materials to the time they are taken out of service. ABB publishes results in Environmental Product Declarations for its customers, investors, and other interested parties.

"To help ourselves succeed and to show that aluminum has high sustainability value, we need to make sure that what we do is transparent and measurable. One tool to do this is Life Cycle Analysis. LCA allows us to demonstrate the long-term value of our products and the renewable nature of aluminum, and to communicate those characteristics to our stakeholders"

John Pizzey, Alcoa, Executive Vice President of Primary Products.

Life Cycle Tools

Life cycle thinking can be put into practice in many ways... involving a number of different "tools". Referring to eco-labels, sustainability indices, and company reports on environmental and social issues helps individual citizens bring life cycle thinking into purchasing decisions. Governments take a life cycle approach to policy making by involving a wide range of stakeholders (such as via Product Panels), life cycle modeling (highlight j), or new policy approaches (such as Integrated Product Policy). In private sector companies, engineers and designers apply life cycle thinking when designing products and services, via studies based on Life Cycle Assessment (highlight h), Total Cost of Ownership calculations (highlight k), Design-for-Environment programs and management systems oriented toward products or facilities. Quantitative and qualitative tools for mapping life cycles and measuring impacts continue to evolve as more professionals apply life cycle thinking and ask for life cycle information.
For more information about these tools, please visit http://www.uneptie.org/pc/sustain/lcinitiative.

j) Modeling the waste stream life cycle in Mexico to promote integrated waste management [vii]

Waste management systems that are environmentally effective and economically affordable are known as Integrated Waste Management systems. Integrated Waste Management uses several different treatment options for waste at a local level and selects these options in context of the entire solid waste stream (including sources and types of waste, recovery options, reuse, and various disposal options). In 2003, Mexico adopted a law promoting an integrated approach to waste management that is supported by life cycle assessment studies. The intent is to ensure that decisions are based on credible data to optimise the waste management system. Computer models of the waste stream life cycle provide this type of information for decision makers. To date, studies on waste characterisation and life cycle modelling are underway in Cuernavaca and Valle de Bravo, Mexico.

A number of different tools are often needed to accomplish one task or meet one objective.

k) Calculating the Total Cost of Ownership – the Life Cycle Costs

A business which makes industrial cleaners worked with its chemical supplier to identify the life cycle costs of manufacturing, purchasing, using, and disposing of the chemicals supplied. Together, they used the results to identify changes in the formulation of the cleaner to reduce these costs. Next, the business approached its customer who purchases the cleaner to wash buses, subway cars, and train cars.
The business calculated that this customer was paying not only for the cleaner, but also for water use, cleaner spilled during use, and unused cleaner discarded as residue in each packaging container. This customer also paid fees for special handling, storage, worker training, and reporting on use of the cleaner to comply with laws and regulations. But so far this customer had never measured these costs or connected them with its choice of cleaner.

Seeing an opportunity to work with its customer, the business designed a cleaning "system" to deliver cleaner to customers in one large container, connect it to a hose, mix it with the exact amount of water, and apply it directly to the buses, subways, and train cars. The system would use less water and less cleaner, eliminate handling and storage, and ensure cleaner wasn't lost as residue in packaging or as "waste" to the environment from spills. By managing all life cycle issues, the system reduces the customer's costs, manages risks to worker health and safety, mitigates environmental impacts, and provides a longer-term contract for the business.

Life Cycle Assessment (LCA), Design for Environment (DfE), Product Service Systems (PSS) & Integrated Product Policy (IPP) are all responses to the identified need for a paradigm shift in our approach to achieving sustainable development – each builds on the concept of life cycle thinking

Life Cycle Thinking Generates Value & Benefits

Overall, life cycle thinking can promote a more sustainable rate of production and consumption and help us use our limited financial and natural resources more effectively. We can derive increased value from money invested – such as wealth creation, accessibility to wealth, health and safety conditions, and fewer environmental impacts – by optimizing output and deriving more benefit from the time, money, and materials we use.

Experts from industry, government, and other organizations agree that making life cycle approaches part of the way we design products, develop services, make policies, and decide what to consume (or what not to consume) will help to halt and possibly reverse some of the damaging trends in our communities and environments... it certainly won't solve all our environmental problems, but it can help us find sustainable ways to tackle some of them.

" ... All decisions in government and business should be scrutinized with the 'sustainability lens', from a life cycle perspective"

Jacqueline Aloisi de Larderel, Former Assistant Executive Director, UNEP

Did you know?

- Some predict the average global temperature to rise 1°Celcius by 2030, due in part to the greenhouse gases we have already emitted into the atmosphere. Our actions today may in fact be determining the climate for 2050.
- The volume of goods and services we consume and discard is offsetting any improvements in production efficiency that Europeans and North Americans made over the past 20 years (highlight d).[viii]
- Exposure to hazardous chemicals from the manufacture, use, and disposal of products has been linked to birth defects and cancer in humans, and substances like mercury, chlordane, and DDT are still accumulating in human tissues, in our planet's polar regions and other sensitive ecosystems.
- In 1999, the average person used 2.3 hectares of productive land and sea – considerably more than 1.9 hectares, which is the earth's carrying capacity?[ix] Our population and our consumption are growing at such a rate that we'll need 4 planets to sustain us by the year 2100.
- The diversity of plants and animals on our planet is decreasing, as is the availability of resources such as timber and freshwater.

Who Is Using Life Cycle Thinking?

The highlights presented throughout this brochure illustrate efforts of several groups, but there are many others currently using a life cycle approach, and more and more are joining them. Especially in developing countries, innovative groups are discovering the life cycle approach as a holistic way to promote social and economic development while respecting our natural environment (highlight l). The fact that governments and prominent global businesses use life cycle thinking – in current operations and in future planning – demonstrates the economic, environmental, and social benefits are tangible.

l) Promoting a Life Cycle Approach in Sustainable Production & Consumption in Eastern & Southern Africa [x]

The Industrial Ecology Institute, a non-profit organization advocates "the application of life cycle thinking in development activities" as "among the latest important contributions by science in pursuit of sustainable development." The Institute maintains that industry's growing acceptance and application of life cycle thinking in many developed countries confirms its potential to strengthen environmental management and policy.
"Of significance to Africa is the critical role the approach can play in...sustainable food production, energy security and natural resource management" and there are several reports on the successful use of life cycle assessment (LCA) in forest management, fertilizer and pesticide selection and crop selection in various developed countries.
The Industrial Ecology Institute is a pioneer in research, development and capacity building.

What Can I Do?

There is a lot that you can do as an individual choosing to buy a product or service; as an employee involved in manufacturing, procurement, human resources, management, health and safety, finance or marketing; or as a government agent in policy, contracting, or planning:

- Ask questions! Ask where the product you are buying originates, how much energy it uses, what it is made of, and what will happen to it when you are done with it.
- Ask the organization you work for about what it is doing to understand the life cycle of the products and services it makes or buys. Learn how your organization's decisions influence others along the life cycle of your product or service.
- Talk with others to learn about their experiences and share yours!
- Pilot small projects that use life cycle thinking within your organization or community.
- Write and speak publicly about the projects in your organization or community. Use clear, simple language and avoid terminology and jargon. Describe what you did, the benefits, and what you found difficult so others might adapt your experience to their situation.
- Contact UNEP's Life Cycle Initiative, to ask for more information – email us at sc@unep.fr.
- Join the Life Cycle Initiative Network – visit www.uneptie.org/sustain/lcinitiative to find out how.

UNEP DTIE

UNEP Division of Technology, Industry and Economics helps decision-makers in government, local authorities, business and industry develop and implement policies that:

- Promote sustainable consumption and production;
- Encourage efficient use of energy;
- Ensure adequate management of chemicals;
- Incorporate environmental costs.

UNEP DTIE activities focus on raising awareness, improving the transfer of information, building capacity, fostering technological cooperation, partnerships and transfer, improving understanding of environmental considerations into economic policies, and catalyzing global chemical safety.

Find more information about UNEP DTIE at http://www.uneptie.org/

SETAC

The Society of Environmental Toxicology and Chemistry (SETAC) is a professional society, in the form of a not-for-profit association, established to promote the use of a multidisciplinary approach to solving problems of the impact of chemicals and technology on the environment. Environmental problems often require a combination of expertise from chemistry, toxicology, and a range of other disciplines to develop effective solutions. SETAC provides a neutral meeting ground for scientists working in universities, governments, and industry who meet, as private persons not bound to defend positions, but simply to use the best science available.

Among other things, SETAC has taken a leading role in the development of Life Cycle Management (LCM) and the methodology of Life Cycle Assessment (LCA). The organisation is often quoted as a reference on LCA matters.

Find more information about SETAC at http://www.setac.org

UNEP / SETAC Life Cycle Initiative

UNEP and SETAC have established a global life cycle assessment initiative. Among other things, the Life Cycle Initiative builds upon and provides support to the ongoing work of UNEP on sustainable consumption and production, such as Industry Outreach, Industrial Pollution Management, Sustainable Consumption, Cleaner and Safer Production, Global Reporting Initiative (GRI), Global Compact, UN Consumer Guidelines, Tourism, Advertising, Eco-design and Product Service Systems. The Initiative's efforts are complemented by SETAC's international infrastructure and its publishing efforts in support of the LCA community.

The Life Cycle Initiative is a response to the call from governments for a life cycle economy in the Malmö Declaration (2000). It contributes to the 10-year framework of programmes to promote sustainable consumption and production patterns, as requested at the World Summit on Sustainable Development (WSSD) in Johannesburg (2002). Our mission is to develop and disseminate practical tools for evaluating the opportunities, risks, and trade-offs associated with products and services over their entire life cycle to achieve sustainable development.

The programmes aim at putting life cycle thinking into practice and at improving the supporting tools through better data and indicators by hosting and facilitating expert groups whose work results in web-based information systems.

1. The Life Cycle Management (LCM) programme creates awareness and improves skills of decision-makers by producing information materials, establishing forums for sharing best practice, and carrying out training programmes in all parts of the world.
2. The Life Cycle Impact Assessment (LCIA) programme increases the quality and global reach of life cycle indicators by promoting the exchange of views among experts whose work results in a set of widely accepted recommendations.
3. The Life Cycle Inventory (LCI) programme improves global access to transparent, high-quality life cycle data.

Find more information about the UNEP/SETAC Life Cycle Initiative at http://www.uneptie.org/pc/sustain/lcinitiative.

Partners of the Life Cycle Initiative (since launch 2002)

Sponsoring Partners

National Institute of Advanced Industrial Science and Technology)/ Japan

Alliance for Beverage Cartons and the Environment

American Plastics Council

PlasticsEurope

CIRAIG/ Government of Canada and Quebec

EcoRecycle, Victoria

FZK Research Centre Karlsruhe / Government of Germany

General Motors

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www.unep.org
United Nations Environment Programme
P.O. Box 30552 Nairobi, Kenya
Tel: (254 2) 621234
Fax: (254 2) 623927
E-mail: cpiinfo@unep.org
web: www.unep.org

UNEP

United Nations Environment Programme
Division of Technology, Industry and Economics
Production and Consumption Branch
Tour Mirabeau, 39-43 quai André Citroën
75739 Paris Cedex 15, France
Tel: +33-1 44 37 14 50 Fax: +33-1 44 37 14 74 Email: unep.tie@unep.fr
Web: www.uneptie.org

4 types of drinking cups used on events: Life Cycle Assessment and Eco-Efficiency Analysis

An Vercalsteren[1], Carolin Spirinckx[1], Willy Sarlée[2]

[1]Flemish Institute for Technological Research (VITO), Integral Environmental Studies, Belgium
[2]Public Waste Agency for the Flemish Region (OVAM), Belgium

Abstract

In commission of OVAM, VITO performed an eco-efficiency analysis based on a life cycle assessment for 4 types of drinking cups used on events. The objective was to gain insight in the environmental impacts and costs related to the respective cup systems in order to outline a well-founded environmental policy with regard to this subject. Since the results of this comparative study are publicly available, a critical review is performed simultaneously with the study.

Keywords

LCA, Eco-Efficiency, drinking cups, events

1 INTRODUCTION

OVAM, the Public Waste Agency for the Flemish Region, wished to gain insight in the environmental and economical aspects related to the use of specific types of cups on events. The main reason for this was the introduction and use of the one-way cup in polylactide (PLA), a renewable material, at events in Belgium. OVAM was especially interested in the comparison between the reusable cups in polycarbonate (PC) on the one hand and the one-way cups that are mostly used on events in Belgium on the other hand.

In commission of OVAM, VITO, the Flemish Institute for Technological Research, conducted a life cycle assessment (LCA) to assess and compare the environmental aspects related to the use of different cups on events. In addition the economical aspects were inventoried and related to the environmental aspects in an eco-efficiency analysis. This paper describes the LCA, the calculation of the environmental and cost indicator and the eco-efficiency analysis.

2 LIFE CYCLE ASSESSMENT

2.1 Goal and scope definition

The LCA-study is performed in accordance with the ISO14040-standards [1-4]. Since the results of this study are available for the stakeholders and the general public, a critical review by a third party was needed. This critical review is performed by TNO and a review panel. All parties (VITO, TNO as reviewer, OVAM as commissioner and stakeholders) preferred to have the review simultaneously performed with the study itself which enabled a discussion and if necessary adjustments during the study.

The functional unit was defined as: “the recipients needed for serving 100 liter beer or soft drinks on a small-scale indoor (2000-5000 visitors) and a large-scale outdoor event (>30 000 visitors)”. This definition includes the production of the cups, the consumption phase (on the event) and the processing of the waste (end-of-life treatment). In the remainder of this paper, small-scale events automatically imply indoor and large-scale events automatically imply outdoor events.

Four alternative types of cups for use on events are examined:

- re-usable cup in polycarbonate (PC);
- one-way cup in polypropylene (PP);
- one-way cup in polyethylene (PE) coated cardboard;
- one-way cup in polylactide (PLA).

For all cup systems the most representative type of cup on the Flemish market is taken into consideration. With regard to the drinking volume this means the 25cl-drinking volume cup (which relates in most cases to the 33cl total volume). All data reflect the specific actual situation in Flanders in the period 2000-2005.

The LCA is extended with an eco-efficiency analysis which includes the calculation of an environmental and cost indicator. In order to study the same system for the environmental aspects and the economical aspects no streamlining is applied for the LCA. All life cycle stages, from the extraction of raw materials to the final waste treatment, are taken into consideration.

2.2 Inventory analysis

If available, specific data supplied by the different stakeholders and relevant for Flanders (and Belgium) were used. Otherwise (more general) data from literature were taken. For aspects where no specific nor literature data were found an assumption was made, based on well-founded arguments.

All data reflect the specific actual situation in Flanders. Data on representative cups, on average number of trips, etc. are specifically directed at the Flemish (Belgian) situation.

The data are not case-specific, but reflect the results within 2 ranges of visitors numbers that relate to either a small-scale (2000-5000 visitors) or a large-scale event (more than 30000 visitors).

The difference between one-way cups and reusable cups is important. In relation to the functional unit (100 l beer or soft drinks) 400 one-way cups with a drinking volume of 25 cl are needed. With regard to the reusable cups, this relation is less well-defined. In this study it is considered that 160 reusable cups are needed for serving 100 l beer on an event. This relates to the given that one reusable cup is used on average 2.5 times at one event.

One other important element in the data inventory was the definition of the trip rate (the number of times (on average) one cup can be used over its entire life) for small indoor respectively large outdoor events. We defined the

trip rate from the perspective of the cup and its use over a number of events, not on one specific event. Taking into account all factors that influence the trip rate, we defined in a basic scenario the following trip rate:

- Small-scale indoor events: 45 trips per cup;
- Large-scale outdoor events: 20 trips per cup.

In a sensitivity analysis a best-case trip rate (100 for small and 40 for large events) and a worst-case trip rate (14 for small and 7 for large events) were considered.

In the study a basic scenario is defined but for the most uncertain and the most relevant parameters a sensitivity analysis is performed additionally.

Figure 1 shows the overall life cycle of the cups that is taken into account.

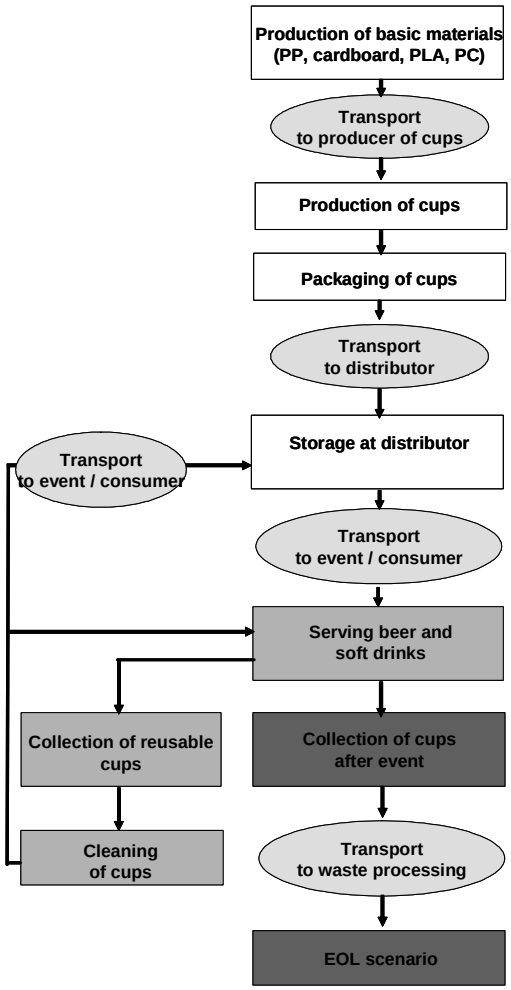

Figure 1: Life cycle tree for the use of cups on events.

2.3 Impact assessment and interpretation

In this study the Eco-indicator 99 (Hierarchist version, H/A) method [5] is used for the impact assessment. The damage categories considered in the study during impact assessment are presented in Table 1.

Environmental Damage Categories	*Unit*
Carcinogenics	*DALY*
Respiratory effects caused by organics	*DALY*
Respiratory effects caused by inorganics	*DALY*
Climate change	*DALY*
Ozone layer	*DALY*
Ecotoxic emissions	*PAF*m²yr*
Acidification/Eutrophication	*PDF*m²yr*
Extraction of minerals	*MJ surplus*
Extraction of fossil fuels	*MJ surplus*

Table 1: Environmental damage categories.

Individual environmental profiles

For the environmental profile of the individual cup systems, the total life cycle of the cups is divided in different life cycle stages. Based on the individual profiles we could conclude that the most important environmental contribution when using reusable PC-cups at small indoor events is caused by the production of the PC-cups, the transport of these cups from the distributor to the event and the return transport from the event back to the distributor. For one-way cups (PP, PE-coated cardboard and PLA) used at small indoor events the production of the cups dominates the environmental profiles. Next in rank is the transportation of the one-way cups from the producer to the distributor.

For large outdoor events, the individual environmental profiles of the one-way cups are very similar to the environmental profiles for small indoor events. The environmental profile of the reusable PC-cup used at large outdoor events, on the other hand, differs from the one for small indoor events. For large outdoor events the production of the PC-cups, the transport of these cups from the producer to the distributor and the cleaning of the cups after the event are the most important life cycle stages in the environmental profile of the PC-cups at large outdoor events.

Comparison of the 4 types of cups

The primary goal of the study was the comparison of the environmental (and economical) aspects between the different types of cups. Therefore the environmental profiles of the 4 types of cups are compared for the different environmental damage categories considered.

The comparison is presented in a diagram in which the cup type with the highest contribution to a particular environmental effect is indicated with a 100% bar. Within this figure the other types of cup (with a lower environmental contribution to a particular effect) are expressed in percentage of the type of cup with the highest contribution.

As defined in the functional unit, we made a distinction between the use of the cups on small and large events. Figure 2 shows the comparative environmental profile for the use of cups on small-scale indoor events, Figure 3 shows the comparison for large-scale outdoor events.

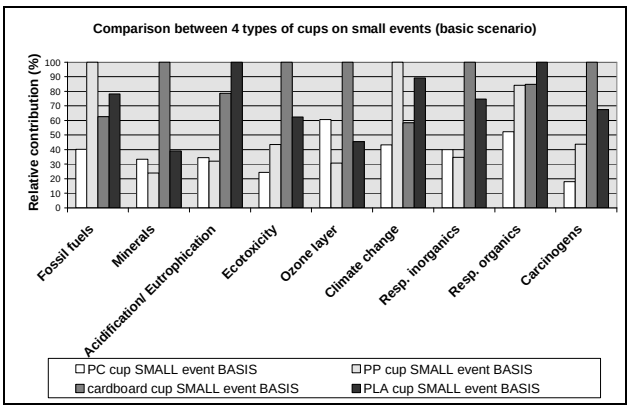

Figure 2: Comparative environmental profile for small-scale indoor events.

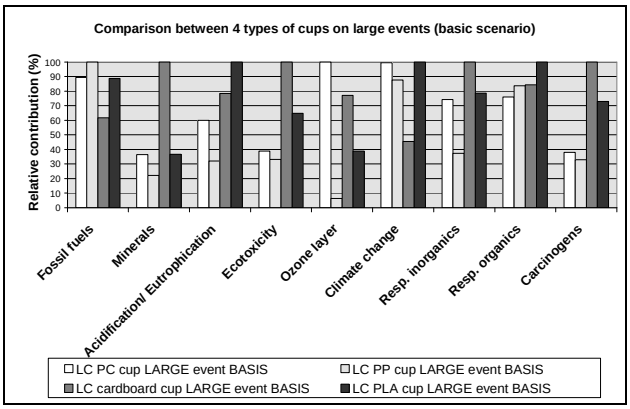

Figure 3: Comparative environmental profile for large-scale outdoor events.

For both type of events, it can be concluded that none of the cup systems has the highest or the lowest environmental score for all environmental damage categories considered in the study. Based on these comparisons it is not possible to make a straightforward conclusion for the selection of the most favorable cup system with regard to the environment.

If we compare individual cup systems between small indoor and large outdoor events, the reusable PC-cup differs the most between both types of events. At small indoor events the PC-cup has never the highest score while for large outdoor events the PC-cup has the highest score for ozone layer depletion and approaches the highest score for climate change. So the environmental burden increases significantly for PC-cups moving to larger scale events. This can be explained by e.g. the lower trip rate and the machine cleaning instead of manual cleaning of the cups after the event. For the other type of cup systems the difference going from a small to a large scale event is negligible.

Sensitivity analyses

Some sensitivity analyses were performed to determine the influence of a change in the inventory data on the results of the impact assessment.

A first sensitivity analysis was performed to evaluate the influence of the number of trips (for both small indoor and large outdoor events), the amount of water and soap used for the cleaning during the event and the cleaning of the cups (by machine instead of manual) after the small indoor event. The analysis confirms that the trip rate is a very determining factor for the results of the study. For both small indoor and large outdoor events the trip rate has a clear effect on the ranking of the different cup types per impact category. Another important conclusion is the fact that the use of double as much water compared to the basic scenario AND soap does not have a significant influence on the individual environmental profile of the PC-cups nor on the comparison with the other cup types.

Other sensitivity analyses were performed to determine the influence of the EOL treatment of the one-way cups. The comparison of the environmental profiles shows that another EOL scenario for the life cycles of the cardboard and PP-cups can influence the results of the total comparison. On the contrary for the PLA-cups the EOL-scenario has a negligible effect on the individual environmental profile and thus also on the comparison between the 4 types of cups.

The PLA-cup system is a relatively new development compared to the other cup systems. The estimated future scenario for the PLA-cups also has a significant influence on the environmental profile of the PLA-cup. Depending on the environmental impact category the impact of the PLA-cup's life cycle decreases with 10-60%. One important factor for this decrease is the lower cup weight, which is a short term option. The reduction of the weight of the PLA-cup with 15% causes a proportional decrease of the environmental contribution of the PLA-cup's life cycle.

3 ECO-EFFICIENCY ANALYSIS

3.1 Environmental indicator

The LCA-results were the basis for the calculation of the environmental indicator. According to ISO 14040 it must be stressed that the calculation of 1 single environmental indicator within a comparative LCA study disclosed to the public is not allowed. However, this part of the study was part of an eco-efficiency analysis. There do not exist ISO standards for eco-efficiency studies, but VITO performed this eco-efficiency study in the line of reasoning of ISO14040.

Various methods are in use to calculate the contribution to the different environmental damage categories further into one environmental indicator. All these methods need some kind of weighting principle to give weight to different environmental aspects in order to calculate 1 single environmental indicator. These methods are not fully scientific and objective, but need some subjective choices. The Eco-indicator 99 method [5] is used in this study.

The following steps were performed to calculate the environmental damage categories further into one environmental indicator:

- normalization: calculating the magnitude of category indicator results relative to reference information
- grouping: sorting and possibly ranking of the impact categories;
- weighting (valuation): converting and possibly aggregating indicator results across impact categories using numerical values based on value-choices.

The results of the weighting according to the Eco-indicator 99 method, using the Hierarchical version, are presented for the 4 types of cup systems that are used at small indoor events respectively large outdoor events in the figures below.

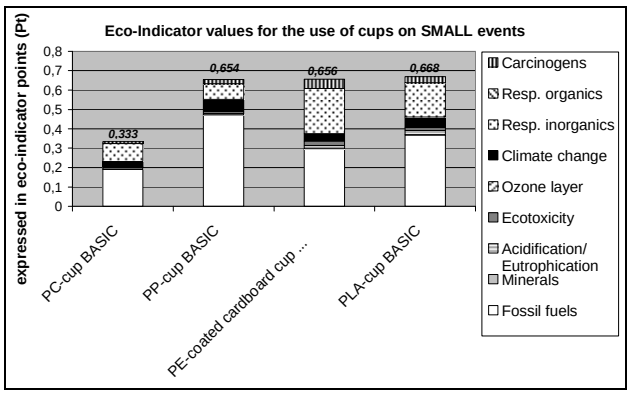

Figure 4: Eco-indicator values for the use of cups on small-scale indoor events.

The eco-indicator values for the use of one-way cups (PP, PE-coated and PLA-cups) on small events are very much comparable to each other. Since the difference between the eco-indicators of the one-way cups is less than 20% we consider it as not being significant. On the other hand the eco-indicator value for the reusable PC-cups, used on small events is significantly (50%) lower.

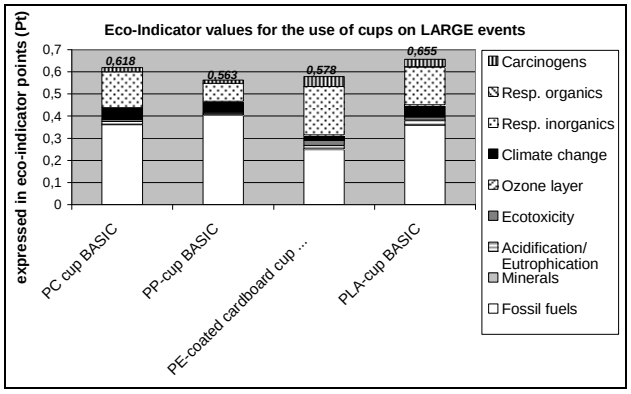

Figure 5: Eco-indicator values for the use of cups on large-scale outdoor events.

The eco-indicator values for the use of cups on large events are comparable for the 4 cup systems that have been studied. In the basic scenario no significant ups or downs appear in the eco-indicator values for the 4 cup systems used on large events.

3.2 Cost indicator

For the calculation of the cost indicator, the viewpoint of society as a whole was adopted. Mostly this matches the viewpoint of the event organizer; some elements were added however. For instance, if the waste is collected by the local authority at its own costs, these costs have been taken up in the cost analysis as well, because the waste collection phase lies entirely within the system boundaries. For the cost analysis, the question of adding up all cost data within the system boundaries is a lot easier than aggregating the environmental impacts. Costs are already expressed in the same units, namely euros. Therefore, no weighting was needed.

The figures below summarize the absolute values of cost indicators for the use of cups on small indoor events respectively large outdoor events.

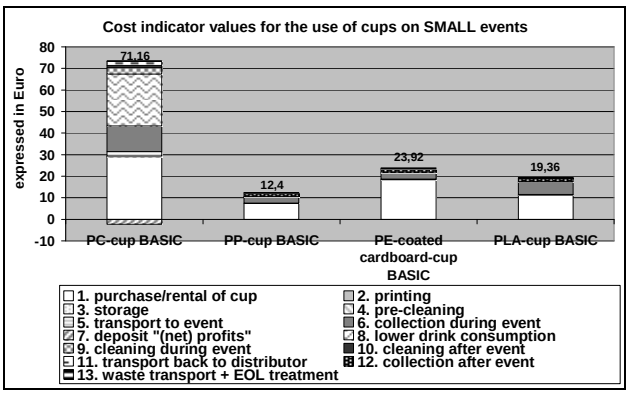

Figure 6: Cost indicator values for the use of cups on small-scale indoor events.

For use on small indoor events, the PP-cup system has the lowest cost indicator. The differences with the other one-way cup systems and the reusable PC-cup system are significant. The cost indicator of the PC-cup system is significantly higher than the 3 other cup systems studied.

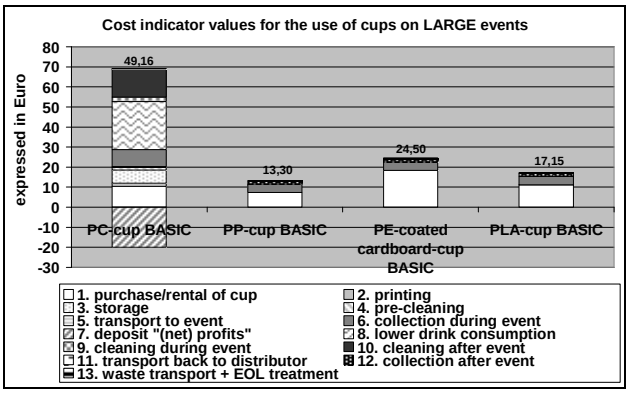

Figure 7: Cost indicator values for the use of cups on large-scale outdoor events.

Using PP-cups on large events costs significantly less than using the other one-way cups and less than the reusable PC-cups. Although the cost indicator of the PC-cup system used at large events is significantly higher than the other 3 cup types, the absolute value is a factor 2 lower than the cost indicator that has been calculated for small events.

3.3 Portfolio analysis

Eco-efficiency has been variously defined and analytically implemented by several workers. In most cases, eco-efficiency is taken to mean the ecological optimization of overall systems while not disregarding economic factors [6]. Eco-efficiency expresses the ratio of economic creation to ecological destruction. However, the improvement of purely ecological factors, for example better utilization of resources through more efficient processes, is also frequently referred to as increased eco-efficiency.

In this eco-efficiency study, the environmental indicator was combined with the cost indicator in a portfolio analysis, per cup system studied. In an EE portfolio presentation both a single environmental score and an economic (cost) score are presented in a two-dimensional graph. The way how to present is definitely not standardized. Several ways of scaling the axes in EE portfolio's are possible. One should realize that these are just ways of presenting the data in a graph with the aim to

give an overview. In fact different methods are possible, they all have in common that only relative scores are calculated and shown in the graph without dimensions on the axes. Evidently the underlying scores nor their accuracy change by using these graphs. We preferred to focus on the differences and therefore applied scaling making use of both the average and the standard deviation of the values of all alternatives. The center point of the graph gets the coordinates (0;0) and represents the average of the options and the difference between an individual score is expressed in the number of standard deviations. It is important to note that the size of the balls does not reflect a specific uncertainty. The uncertainty margins, for the eco-indicator as well as for the cost indicator, are graphically shown as the X and Y error bars in dotted lines. We considered for the absolute cost indicator an uncertainty margin of +/-10% (because of price differences among the suppliers). We took into account an uncertainty margin of +/-20% for the absolute environmental indicators, because of the uncertainty range of the inventory data in combination with the uncertainty range of the weighting methodology. These uncertainty margins are needed to show the significance of differences in cost and environmental indicator. For the portfolio these uncertainty margins on absolute values were scaled.

In this EE portfolio the option that simultaneously scores the lowest cost and the lowest environmental score is considered to be the most eco-efficient. On the contrary the option that simultaneously is most expensive and causes the highest environmental impact is considered to be the least eco-efficient. As a help for interpretation a compass needle is added in the legend that indicates that whenever an option is located more in down left position compared to another option it is considered more eco-efficient. Of course one should check whether this difference is significant.

VITO has chosen to derive conclusions about eco-efficiency from the EE portfolio considering both dimensions (environmental and economic) individually and in its combination and considering options to be most eco-efficient when both dimensions are better and considering options to be least eco-efficient when both dimensions are worse. When the best environmental option simultaneously is the most expensive option this will not lead to conclusions about whether the option is more, less or equally eco-efficient, but it does lead directly to environmental policy recommendations to consider the promotion of this option. This is only recommended when there is a significant difference between the options.

Figure 8 shows the portfolio analysis for the use of cups (according to the basic scenario) on small indoor events. The portfolio analysis shows that the PP-, PLA- and PE-coated cardboard cup systems have approximately the same environmental impact (horizontal axis) but a different cost indicator value. The PP-cup system has the lowest costs related from the viewpoint of the organizers. The cost difference with the PLA- and the cardboard cup system are significant. The environmental indicator value of the reusable PC-cup systems is significantly lower, the cost indicator value of the reusable PC-cup system on the contrary is significantly higher than the 3 other cup systems.

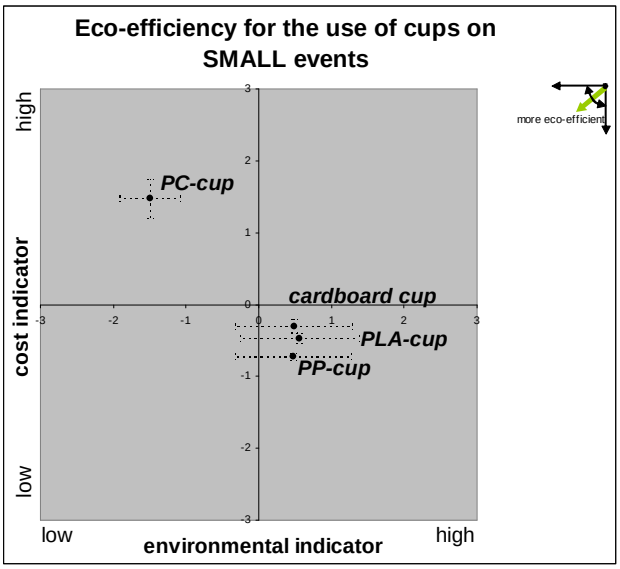

Figure 8: Portfolio analysis for the use of cups on small-scale indoor events.

The reusable PC-cup system clearly has the lowest environmental impact of the 4 cup types, but the costs related to this system are much higher and therefore do not initiate organizers to use this type of cups. Therefore, from an environmental policy point of view, it can be considered to promote the use of reusable PC-cups on small events. One possibility would be to lower the costs for the organizers by giving subsidies for the use of reusable PC-cups, so that the costs approach the costs related to the use of PP-cups. Of course it is up to the policy makers to assess whether this policy option is worth the effort and compare them to other policy options with their environmental benefits and economic costs.

Figure 9 presents the portfolio diagram for the use of cups (according to the basic scenario) on large outdoor events. Taking account of the uncertainty areas the 4 cup systems do not differ significantly with regard to the environmental indicator values but the costs related to the 4 cup systems show significant differences. Using PP-cups on a large event costs significantly less than using cardboard cups and this difference becomes even higher if we compare the costs of the PP-cup system with the reusable PC-cup system. The costs of the PC-cup system are significantly higher than the other 3 cup types.

Due to the insignificant environmental difference between all options there is no reason for a promoting or discouraging policy.

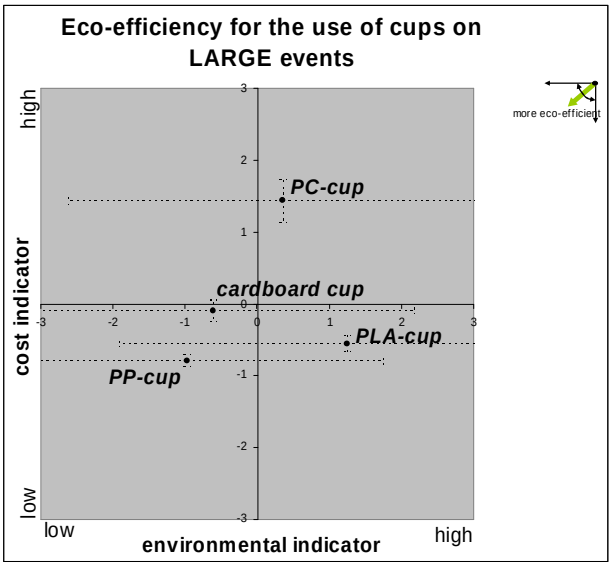

Figure 9: Portfolio analysis for the use of cups on large-scale outdoor events.

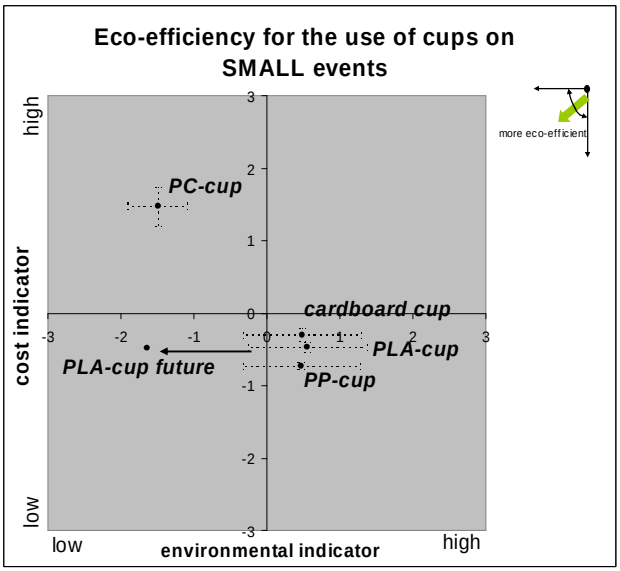

Figure 10: Portfolio analysis for the use of cups on small-scale indoor events with the sensitivity analysis – future scenario for PLA-cups.

4 GENERAL POLICY CONCLUSIONS

From this comparative LCA study according to ISO, none of the four considered cup systems has overall superior or inferior performance neither on small nor large events. This means that there are no scientific arguments for a policy of encouraging or discouraging one of the four cup systems. A policy development would need subjective values in it's decision process.

The eco-efficiency assessment (with it's subjective choices and limitations, that the commissioner of the study realizes and supports in the context of this study) has shown that in the base case for small events the PC cup system shows a significant more favorable environmental score than the other three cup systems on the market. As the costs of the re-usable PC cup system are higher, a policy of promoting the system can be considered based on the more favorable environmental score. Policy makers should agree on the subjective value choices made while weighting different impact or damage categories.

The PLA material and the scale of it's application is still changing rapidly. In the near future (within 1 or 2 years) the environmental score for the PLA cup system might improve significantly (see figure 10 below for small indoor events). If this becomes reality the policy of promoting the use of re-usable PC-cups should be reconsidered, taking into account the improvements that the PC-cup system alternatively might achieve by that time.

REFERENCES

[1] ISO standard 14040, 1997 (LCA - principles and framework)

[2] ISO standard 14041, 1998 (LCA - goal and scope definition and inventory analysis)

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CONTACT

An Vercalsteren

VITO, Integral Environmental Studies, Boeretang 200, B-2400 Mol, Belgium, an.vercalsteren@vito.be

U.S. Securities and Exchange Commission

Speech by SEC Commissioner: Statement at Open Meeting — Interpretive Release Regarding Disclosure of Climate Change Matters

by

Commissioner Kathleen L. Casey

U.S. Securities and Exchange Commission

Washington, D.C.
January 27, 2010

Thank you very much, Madam Chairman.

Like you, I also want to thank the Division of Corporation Finance, and the other Divisions and Offices that participated in drafting this release for your work in drafting this guidance.

Regrettably, because this interpretive release is unnecessary, and addresses concerns unrelated to investor protection, I am unable to support it.

In addition, I question the timing of this release and the priorities underlying our dedication of valuable staff resources to this release, in light of the significant issues facing the Commission, such as securities market structure, proxy "plumbing," securitization, credit rating agencies and IFRS, among others. As we begin to emerge from the worst financial crisis in generations, our consideration of this release today sends a curious signal to the investment community about what we view as the most pressing issues facing the Commission.

Furthermore, I believe that the release is premised on the false notion that registrants may not recognize that disclosure related to "climate change" issues may be required. In truth, our disclosure regime related to environmental issues including climate change is highly developed and robust, and registrants are well aware of, and have decades of experience complying with, these disclosure requirements. In fact, notably, the release does not attempt to make the case that disclosures relating to climate change have been consistently deficient.

There is undoubtedly a constituency that is interested in, and has long pressed the Commission to require, more extensive disclosures on environmental issues in order to drive particular environmental policy objectives. The issuance of this release, however, at a time when the state of the science, law and policy relating to climate change appear to be increasingly in flux, makes little sense.

Most importantly, I do not believe that this release will result in greater availability of material, decision-useful information geared toward the needs

of the broad majority of investors.

In light of these facts, I can only conclude that the purpose of this release is to place the imprimatur of the Commission on the agenda of the social and environmental policy lobby, an agenda that falls outside of our expertise and beyond our fundamental mission of investor protection.

The Release

Turning to the release itself, the guidance discusses the requirement under the Commission's existing rules that registrants discuss the costs, risks and opportunities they face in two broad areas:

- First, the legal requirements and reputational pressures on companies arising from climate change issues; and
- Second, the potential effects of physical changes that, it is theorized, may result from the accretion of so-called "greenhouse gasses" in the atmosphere.

Legal Requirements and Reputational Pressures

Legal requirements related to climate change that registrants may need to discuss include existing and potential legislation, regulation, and litigation that affect registrants directly or indirectly, including by virtue of their effect on customers and suppliers. The release notes that reputational pressures would include the risk, depending on the nature of a registrant's business and its sensitivity to public opinion, that the public's perception of any publicly available data relating to its greenhouse gas emissions might expose it to adverse consequence in its business operations or financial condition.

Legal requirements and reputational pressures relating to climate change issues are, fundamentally, no different than those that arise in other regulatory contexts, albeit climate change is currently a "hotter" and more controversial political topic than most other regulatory issues. Granted, the Commission has promulgated rules requiring disclosure of specified information relating to environmental regulation, which it has not done in other regulatory areas, and has issued more guidance relating specifically to environmental issues than it has with respect to other individual regulatory issues.

Nevertheless, the disclosure guidance in this release relating to legal requirements and reputational pressures would apply with equal force to any other legal and regulatory regime affecting public companies.

Nor, as I previously mentioned, does the release attempt to suggest that registrants' disclosures in this area have been chronically or disproportionately insufficient compared to their disclosures in other areas, or that our disclosure requirements in this area are poorly understood. Simply stated, there is no credible reason to single out climate change issues for discussion.

Furthermore, although the release does a fine job summarizing existing disclosure obligations that may apply to climate change issues, I do not believe that the release changes or clarifies in any meaningful way the common understanding of these disclosure obligations.

As a result, I do not believe that interpretive guidance relating to disclosure of the effects of legal requirements and reputational pressures on registrants in the context of climate change is necessary or appropriate.

Potential Physical Effects of Climate Change

Of far greater concern to me is the disclosure guidance relating to the potential physical effects of climate change. Examples cited in the release include:

- changes in the availability of natural resources on which a registrant relies, and
- hazards to coastal properties securing loans made by a registrant, such as a bank.

This guidance is premature at best, as the science surrounding global warming remains far from settled. In fact, rather than the scientific community coalescing around a consensus, the debate remains vigorous, and revelations in recent months have called into question the integrity of key data and the credibility of the science underlying some climate change theories and predictions.

I do not pretend to be an expert on climate change issues and, indeed, the mission of the Commission is not to opine on climate change issues or other matters of science. Nevertheless, this guidance assumes that man-made global warming and climate change are occurring as a result of greenhouse gas emissions and are likely to result in physical effects that will affect the businesses of registrants.

I recognize the value, under appropriate circumstances, of Commission guidance on disclosure when emerging issues — where registrants do not yet have significant experience drafting disclosure — may have a material effect on registrants' businesses. For instance:

- in 1988, the Commission issued disclosure guidance — primarily for issuers that were reliant on defense contracts with the federal government — relating to the government's ongoing investigation of defense contract procurement practices; and
- in 1998, the Commission issued disclosure guidance relating to the anticipated "Y2K" phenomenon.

There are significant differences between climate change and those emerging issues, however, that make those precedents inapt. In particular, the risks to registrants presented by those emerging issues were unambiguous, virtually undisputed, and imminent. A defense contractor that employed the procurement practices under investigation in 1988 unquestionably faced risks to its business, financial condition and results of operations within months or, at most, a few years. Similarly, companies whose businesses were reliant on computer systems — indeed, the global economy — faced the risk that these systems would fail, potentially crippling some businesses on a date certain in the very near future — January 1, 2000.

By contrast, there is an ongoing, intense and fluid scientific debate about the relative contribution of human activity, especially the emission of greenhouse gases, to climate change, and about the risks that climate

change poses. And even assuming that a consensus on the science of climate change existed, the time-horizon for any potential effects are widely acknowledged to be measurable in decades if not centuries.

No Advancement of Investor Interests; Risk of Harm

I have previously stated that my governing principle in deciding whether to support any interpretive guidance or new disclosure rules — relating to climate change or in any other area — is that the Commission's action must be driven by investor needs and designed to elicit material, decision-useful information for investors, rather than advancing an agenda unrelated to investor protection.

I believe that this release fails to advance the interests of investors. Indeed, if as a result of this release, issuers increase climate change-related disclosures that are not truly decision-useful for investors, ironically we will have harmed investors by increasing registrants' regulatory burden and diverting company resources, making disclosure more cumbersome, and diverting the resources of the Commission itself.

Future of Climate Change Disclosures in Commission Filings

Finally, the release makes reference to potential additional interpretive guidance or rulemakings related to climate change disclosure in the future. While I will, of course, consider any proposed guidance or rules on their merits, my concerns about the appropriate priorities and focus of the Commission and the use of the securities laws to promote an agenda unrelated to investor protection would of course apply with equal force to this analysis.

Again, I very much appreciate the staff's work, but I cannot support the release. I have no questions.

http://www.sec.gov/news/speech/2010/spch012710klc-climate.htm

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Speech by SEC Commissioner: Responding to Investors' Requests for SEC Guidance on Disclosures of Risks Related to Climate Change

by

Commissioner Luis A. Aguilar

U.S. Securities and Exchange Commission

Washington, D.C.
January 27, 2010

Good morning. Let me add my thanks to the staff for their work on this interpretive release. I also thank the investors, organizations, and officers of state governments that provided the Commission with their thoughtful petition for interpretive guidance related to climate risk disclosure. I think both investors and corporations will find the guidance before us today extremely useful.

Over two years ago, the Intergovernmental Panel on Climate Change concluded that it is "unequivocal" that the Earth's climate is warming. In October of last year, 13 federal agencies and departments published a coordinated annual report to Congress that reached the same conclusion.[1] It is expected that climate change, if unchecked, will result in severe harm to ecosystems and people around the world.

So it is no surprise that regulation of greenhouse gases has the attention of state governments, Capitol Hill, and the Environmental Protection Agency, as well as the attention of investors and companies.

Against this backdrop of a changing climate and changing legislative and regulatory landscapes, it is only natural that there are questions about what companies should be disclosing to investors. Today's release is an important step toward answering these questions. By explaining what our existing rules currently require with respect to climate change disclosure, today's release should help companies comply.

In particular, today's release clarifies the responsibility of companies to discuss:

- First, the direct effects of existing and pending environmental regulation, legislation, and international treaties on the company's business, its operations, risk factors, and in Management's Discussion and Analysis of Financial Condition and Results of Operations (MD&A).

- Second, the *indirect* effects of such legislation and regulation on a company's business, such as changes in demand for products that create or reduce greenhouse gas emissions.

- Third, the effect on a company's business and operations related to the physical changes to our planet caused by climate change — such as rising seas, stronger storms, and increased drought. These changes to the environment could have a number of material effects on corporations, such as impairing the distribution and production of goods and damaging property, plant, and equipment.

Climate change and related governmental action can create risks and opportunities for companies. It is clear that disclosure of this material information will inform and aid investors in their decision making. It is often said that MD&A is the place to disclose the issues keeping management up at night. This release clarifies that effects resulting from climate change that are keeping management up at night should be disclosed to investors. Additionally, today's interpretive release should facilitate disclosure to investors regarding regulatory restrictions on greenhouse gas emissions that would materially change a company's business and future prospects.

I would also like to emphasize two practical points that companies should keep in mind when preparing their disclosure.

Companies should know their emissions information in order to evaluate the risks

First, a company needs to consider whether it has an effective system for collecting information about its emissions. When evaluating whether disclosure of the possible effects of pending climate change legislation, such as the federal cap and trade legislation, is required, a company may need to consider whether the legislation or regulation, if enacted, is reasonably likely to have a material effect on it. Therefore, as we say in the release, "management should ensure that it has sufficient information regarding the registrant's greenhouse gas emissions and other operational matters to evaluate the likelihood of a material effect arising from the subject legislation or regulation."

Registrants should focus on investors when considering whether information is material

Second, if there is a close question about whether or not information is material, the company should decide in favor of disclosure to investors. I remind companies of this principle because the items discussed in the release before us generally require disclosure only of information that is material.

As the Supreme Court has explained, doubts about materiality will be "commonplace," but these doubts should be resolved in favor of investors.[2] Similarly, previous Commission MD&A guidance clearly requires disclosure of known trends, events, or uncertainties where materiality is uncertain.[3]

Conclusion

The Commission's action today is a first step in an area where the Commission will begin to play a more proactive role, consistent with our mandate under the National Environmental Policy Act of 1969, to consider the environment in our regulatory action. The National Environmental Policy Act charged the Federal Government "to use all practicable means" to, among other things, "fulfill the responsibilities of each generation as trustee of the environment for succeeding generations."[4]

Accordingly, I look forward to the Commission's roundtable on climate change to be held later this year. I also look forward to the ongoing work of the Commission's Investor Advisory Committee regarding enhanced environmental, social, and governance disclosures. As the sponsor of the Investor Advisory Committee, I commend the committee members for taking up these matters as one of the many issues within the committee's broad mandate.

Thank you.

Endnotes

[1] *See*, *Our Changing Planet: The U.S. Climate Change Science Program for Fiscal Year 2010* (stating that "Recent studies have (1) shown through observations that warming of the climate is unequivocal; (2) the global warming observed over the past 50 years is due primarily to human-induced emissions of heat-trapping gases; and (3) these emissions come mainly from the burning of fossil fuels (coal, oil, and gas), with important contributions from the clearing of forests, agricultural practices, and other activities."). The U.S. Global Change Research Program (USGCRP) coordinates and integrates federal research on changes in the global environment and their implications for society. The USGCRP began as a presidential initiative in 1989 and was mandated by Congress in the Global Change Research Act of 1990 (P.L. 101-606). The program comprises the Department of Commerce, Department of Defense, Department of Energy, Department of the Interior, Department of State, Department of Transportation, Department of Health and Human Services, National Aeronautics and Space Administration, National Science Foundation, Smithsonian Institution, Agency for International Development, Department of Agriculture, and the Environmental Protection Agency.

[2] In the leading case on materiality, TSC Industries, Inc. v. Northway, Inc., the Court recognized that doubts as to materiality of information would be commonplace, but that, particularly in view of the prophylactic purpose of the securities laws and the fact that disclosure is within management's control, "it is appropriate that these doubts be resolved in favor of those the statute is designed to protect." TSC Industries, Inc. v. Northway, Inc., 426 U.S. 438, 448 (1976).

[3] *See*, Interpretive Release: Management's Discussion and Analysis of Financial Condition and Results of Operations; Certain Investment Company Disclosures, Release No. 33-6835 (May 18, 1989) [54 FR 22427] (noting that, as to the disclosure of a known uncertainty, disclosure is required in MD&A unless management can determine that the uncertainty is not reasonably likely to occur, and, if that determination cannot be made, then management must assume the event occurs and make disclosure unless management determines that a material effect on the registrant is *not* reasonably likely to occur.).

[4] The National Environmental Policy Act of 1969, Pub. L. 91-190, codified at 42 U.S.C. § 4321 *et seq*.

http://www.sec.gov/news/speech/2010/spch012710laa-climate.htm

Federal Register

Monday,
February 8, 2010

Part III

Securities and Exchange Commission

17 CFR Parts 211, 231 and 241
Commission Guidance Regarding Disclosure Related to Climate Change; Final Rule

SECURITIES AND EXCHANGE COMMISSION

17 CFR Parts 211, 231 and 241

[Release Nos. 33–9106; 34–61469; FR–82]

Commission Guidance Regarding Disclosure Related to Climate Change

AGENCY: Securities and Exchange Commission.

ACTION: Interpretation.

SUMMARY: The Securities and Exchange Commission ("SEC" or "Commission") is publishing this interpretive release to provide guidance to public companies regarding the Commission's existing disclosure requirements as they apply to climate change matters.

DATES: *Effective Date:* February 8, 2010.

FOR FURTHER INFORMATION CONTACT: Questions about specific filings should be directed to staff members responsible for reviewing the documents the registrant files with the Commission. For general questions about this release, contact James R. Budge at (202) 551–3115 or Michael E. McTiernan, Office of Chief Counsel at (202) 551–3500, in the Division of Corporation Finance, U.S. Securities and Exchange Commission, 100 F Street, NE., Washington, DC 20549.

SUPPLEMENTARY INFORMATION:

I. Background and Purpose of Interpretive Guidance

A. Introduction

Climate change has become a topic of intense public discussion in recent years. Scientists, government leaders, legislators, regulators, businesses, including insurance companies, investors, analysts and the public at large have expressed heightened interest in climate change. International accords, federal regulations, and state and local laws and regulations in the U.S. address concerns about the effects of greenhouse gas emissions on our environment,[1] and international efforts to address the concerns on a global basis continue.[2] The Environmental Protection Agency is taking action to address climate change concerns,[3] and Congress is considering climate change legislation.[4] Some business leaders are increasingly recognizing the current and potential effects on their companies' performance and operations, both positive and negative, that are associated with climate change and with efforts to reduce greenhouse gas emissions.[5] Many companies are providing information to their peers and to the public about their carbon footprints and their efforts to reduce them.[6]

This release outlines our views with respect to our existing disclosure requirements as they apply to climate change matters. This guidance is intended to assist companies in satisfying their disclosure obligations under the federal securities laws and regulations.

B. Background

1. Recent Regulatory, Legislative and Other Developments

In the last several years, a number of state and local governments have enacted legislation and regulations that result in greater regulation of greenhouse gas emissions.[7] Climate change related legislation is currently pending in Congress. The House of Representatives has approved one version of a bill,[8] and a similar bill was introduced in the Senate in the fall of 2009.[9] This legislation, if enacted, would limit and reduce greenhouse gas emissions through a "cap and trade" system of allowances and credits, among other provisions.

The Environmental Protection Agency has been taking steps to regulate greenhouse gas emissions. On January 1, 2010, the EPA began, for the first time, to require large emitters of greenhouse gases to collect and report data with respect to their greenhouse gas emissions.[10] This reporting requirement is expected to cover 85% of the nation's greenhouse gas emissions generated by roughly 10,000 facilities.[11] In December 2009, the EPA issued an "endangerment and cause or contribute finding" for greenhouse gases under the Clean Air Act, which will allow the EPA to craft rules that directly regulate greenhouse gas emissions.[12]

Some members of the international community also have taken actions to address climate change issues on a global basis, and those actions can have a material impact on companies that report with the Commission. One such effort in the 1990s resulted in the Kyoto Protocol. Although the United States has never ratified the Kyoto Protocol, many registrants have operations outside of the United States that are subject to its standards.[13] Another important international regulatory system is the European Union Emissions Trading System (EU ETS), which was launched as an international

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[1] For a listing of state and local government laws and regulations in this field, *see http://www.epa.gov/climatechange/wycd/stateandlocalgov/index.html*. Two significant international accords related to this topic are the Kyoto Protocol, which was adopted in Kyoto, Japan, on December 11, 1997 and became effective on February 16, 2005, and the European Union Emissions Trading System (EU ETS), which was launched as an international "cap and trade" system of allowances for emitting carbon dioxide and other greenhouse gases, built on the mechanisms set up under the Kyoto Protocol. *See http://unfccc.int/kyoto_protocol/items/2830.php* and *http://ec.europa.eu/environment/climat/pdf/brochures/ets_en.pdf* for a more detailed discussion of the Kyoto Protocol and EU ETS, respectively.

[2] For example, in December 2009, Copenhagen, Denmark hosted the United Nations Climate Change Conference.

[3] *See e.g.*, Current and Near-Term Greenhouse Gas Reduction Initiatives, available at *http://www.epa.gov/climatechange/policy/neartermghgreduction.html*, for a discussion of EPA initiatives as well as other federal initiatives.

[4] *See e.g.*, American Clean Energy and Security Act of 2009, H.R. 2454, 111th Cong., 1st Sess. (2009), passed by the House of Representatives on June 26, 2009, and Clean Energy Jobs and American Power Act of 2009, S. 1733, 111th Cong., 1st Session (2009), introduced in the Senate September 30, 2009.

[5] *See* Appendix F to the Petition for Interpretive Guidance on Climate Risk Disclosure submitted September 18, 2007, File No. 4–547, for a sampling of comments by business leaders relating to climate change regulation and disclosure, available at *http://www.sec.gov/rules/petitions/2007/petn4-547.pdf*.

[6] Companies are assessing and reporting on their greenhouse gas emissions and other climate change related matters using standards and guidelines promulgated by organizations with specific expertise in the field. Three such organizations are the Climate Registry, the Carbon Disclosure Project and the Global Reporting Initiative. We discuss this in more detail below.

[7] For example, in California, the Global Warming Solutions Act of 2006 and regulatory actions by the California Air Resources Board have resulted in restrictions on greenhouse gas emissions. In addition, state and regional programs, such as the Regional Greenhouse Gas Initiative (including ten Northeast and Mid-Atlantic states), the Western Climate Initiative (including seven Western states and four Canadian provinces) and the Midwestern Greenhouse Gas Reduction Accord (including six states and one Canadian province) have been developed to restrict greenhouse gas emissions. For a more detailed list of state action on climate change, *see* Pew Center on Global Climate Change, States News (available at *http://www.pewclimate.org/states-regions/news?page=1*).

[8] *See* American Clean Energy and Security Act of 2009.

[9] *See* Clean Energy Jobs and American Power Act of 2009.

[10] *See* Mandatory Reporting of Greenhouse Gases, Docket No. EPA–HQ–OAR–2008–0508, 74 FR 56260 (October 30, 2009).

[11] *See* EPA Press Release "EPA Finalizes the Nation's First Greenhouse Gas Reporting System/ Monitoring to begin in 2010" dated September 22, 2009, available at *http://yosemite.epa.gov/opa/admpress.nsf/d0cf6618525a9efb85257359003fb69d/194e412153fcffea8525763900530d75!OpenDocument*.

[12] Endangerment and Cause or Contribute Findings for Greenhouse Gases Under Section 202(a) of the Clean Air Act, Docket ID No. EPA–HQ–OAR–2009–0171, 74 FR 66496 (December 15, 2009). The Clean Air Act is found in 42 U.S.C. ch. 85.

[13] One of the major features of the Kyoto Protocol is that it sets binding targets for industrialized countries for reducing greenhouse gas emissions. These amount to an average of five per cent against 1990 levels over the five-year period 2008–2012.

"cap and trade" system of allowances for emitting carbon dioxide and other greenhouse gases, based on mechanisms set up under the Kyoto Protocol.[14] In addition, the United States government is participating in ongoing discussions with other nations, including the recent United Nations Climate Conference in Copenhagen, which may lead to future international treaties focused on remedying environmental damage caused by greenhouse gas emissions. Those accords ultimately could have a material impact on registrants that file disclosure documents with the Commission.[15]

The insurance industry is already adjusting to these developments. A 2008 study listed climate change as the number one risk facing the insurance industry.[16] Reflecting this assessment, the National Association of Insurance Commissioners recently promulgated a uniform standard for mandatory disclosure by insurance companies to state regulators of financial risks due to climate change and actions taken to mitigate them.[17] We understand that insurance companies are developing new actuarial models and designing new products to reshape coverage for green buildings, renewable energy, carbon risk management and directors' and officers' liability, among other actions.[18]

2. Potential Impact of Climate Change Related Matters on Public Companies

For some companies, the regulatory, legislative and other developments noted above could have a significant effect on operating and financial decisions, including those involving capital expenditures to reduce emissions and, for companies subject to "cap and trade" laws, expenses related to purchasing allowances where reduction targets cannot be met. Companies that may not be directly affected by such developments could nonetheless be indirectly affected by changing prices for goods or services provided by companies that are directly affected and that seek to reflect some or all of their changes in costs of goods in the prices they charge. For example, if a supplier's costs increase, that could have a significant impact on its customers if those costs are passed through, resulting in higher prices for customers. New trading markets for emission credits related to "cap and trade" programs that might be established under pending legislation, if adopted, could present new opportunities for investment. These markets also could allow companies that have more allowances than they need, or that can earn offset credits through their businesses, to raise revenue through selling these instruments into those markets. Some companies might suffer financially if these or similar bills are enacted by the Congress while others could benefit by taking advantage of new business opportunities.

In addition to legislative, regulatory, business and market impacts related to climate change, there may be significant physical effects of climate change that have the potential to have a material effect on a registrant's business and operations. These effects can impact a registrant's personnel, physical assets, supply chain and distribution chain. They can include the impact of changes in weather patterns, such as increases in storm intensity, sea-level rise, melting of permafrost and temperature extremes on facilities or operations. Changes in the availability or quality of water, or other natural resources on which the registrant's business depends, or damage to facilities or decreased efficiency of equipment can have material effects on companies.[19] Physical changes associated with climate change can decrease consumer demand for products or services; for example, warmer temperatures could reduce demand for residential and commercial heating fuels, service and equipment.

For some registrants, financial risks associated with climate change may arise from physical risks to entities other than the registrant itself. For example, climate change-related physical changes and hazards to coastal property can pose credit risks for banks whose borrowers are located in at-risk areas. Companies also may be dependent on suppliers that are impacted by climate change, such as companies that purchase agricultural products from farms adversely affected by droughts or floods.

3. Current Sources of Climate Change Related Disclosures Regarding Public Companies

There have been increasing calls for climate-related disclosures by shareholders of public companies. This is reflected in the several petitions for interpretive advice submitted by large institutional investors and other investor groups.[20] The New York

[14] *See* n. 1, *supra*.

[15] The terms of the Kyoto Protocol are set to expire in 2012. Ongoing international discussions, including the United Nations Climate Change Conference held in Copenhagen, Denmark in mid-December 2009, are intended to further develop a framework to carry on international greenhouse gas emission reduction standards beyond 2012.

[16] *Strategic business risk 2008—Insurance*, a report prepared by Ernst & Young and Oxford Analytica. *See* Ernst & Young press release dated March 12, 2008, available at *http://www.ey.com/GL/en/Newsroom/News-releases/Media_Press-Release_Strategic-Risk-to-Insurance-Industry*.

[17] On March 17, 2009, the NAIC adopted a mandatory requirement that insurance companies disclose to regulators the financial risks they face from climate change, as well as actions the companies are taking to respond to those risks. All insurance companies with annual premiums of $500 million or more will be required to complete an Insurer Climate Risk Disclosure Survey every year, with an initial reporting deadline of May 1, 2010. The surveys must be submitted in the state where the insurance company is domesticated. *See Insurance Regulators Adopt Climate Change Risk Disclosure*, available at *www.naic.org/Releases/2009_docs/climate_change_risk_disclosure_adopted.htm*.

[18] *See* Klein, Christopher, *Climate Change, Part IV: (Re)insurance Industry response*, May 28, 2009, available at *www.gccapitalideas.com/2009/05/28/climate-change-part-iv-reinsurance-industry-response*.

[19] For one view of the anticipated business-related physical risks resulting from climate change, *see Industry Update: Global Warming & the Insurance Industry—Will Insurers Be Burned by the Climate Change Phenomenon?*, available at *http://www.aon.com/about-aon/intellectual-capital/attachments/risk-services/will_insurers_be_burned_by_the_climate_change_phenomenon.pdf*. Another example of how physical risks attributable to climate change are changing business and risk assessments is the Federal Emergency Management Agency's plan to update its risk mapping, assessment and planning to better reflect the effects of climate change, such as changing rainfall data, and hurricane patterns and intensities. *See* "Risk Mapping, Assessment, and Planning (Risk MAP): Fiscal Year 2009 Flood Mapping Production Plan," Version 1, May 2009, available at *http://www.fema.gov/library/viewRecord.do?id=3680*.

[20] *See* Petition for Interpretive Guidance on Climate Risk Disclosures, dated September 19, 2007, File No. 4-547, available at *http://www.sec.gov/rules/petitions/2007/petn4-547.pdf*; supplemental petition dated June 12, 2008, available at *http://www.sec.gov/rules/petitions/2008/petn4-547-supp.pdf*; second supplemental petition dated November 23, 2009, available at *http://www.sec.gov/rules/petitions/2009/petn4-547-supp.pdf*. For other petitions on point, *see also* Petition for Interpretive Guidance on Business Risk of Global Warming Regulation, submitted on behalf of the Free Enterprise Action Fund on October 22, 2007, File Number 4–549, available at *http://www.sec.gov/rules/petitions/2007/petn4-549.pdf*. One petition urges the Commission to issue guidance warning companies not to include information on climate change that may be false and misleading; *see* Petition for Interpretive Guidance on Public Statements Concerning Global Warming and Other Environmental Issues, submitted on behalf of the Free Enterprise Action Fund on July 21, 2008, File No. 4-563, available at *http://www.sec.gov/rules/petitions/2008/petn4-563.pdf*. While not a formal petition, Ceres has provided the Commission with the results of a study it commissioned in conjunction with the Environmental Defense Fund regarding climate risk disclosure in SEC filings and suggests that the Commission issue guidance on this topic. *See* Climate Risk Disclosure in SEC Filings: An Analysis of 10–K Reporting by Oil and Gas, Insurance, Coal, and Transportation and Electric Power Companies, June 2009, available at *http://www.ceres.org/Document.Doc?id=473*.

The Subcommittee on Securities, Insurance, and Investment of the Senate Committee on Banking,

Continued

Attorney General's Office recently has entered into settlement agreements with three energy companies under its investigation regarding their disclosures about their greenhouse gas emissions and potential liabilities to the companies resulting from climate change and related regulation. The companies agreed in the settlement agreements to enhance their disclosures relating to climate change and greenhouse gas emissions in their annual reports filed with the Commission.[21]

Although some information relating to greenhouse gas emissions and climate change is disclosed in SEC filings,[22] much more information is publicly available outside of public company disclosure documents filed with the SEC as a result of voluntary disclosure initiatives or other regulatory requirements. For example, in addition to the disclosure requirements mandated in several states [23] and the disclosure that the EPA began requiring at the start of 2010, The Climate Registry provides standards for and access to climate-related information. The Registry is a non-profit collaboration among North American states, provinces, territories and native sovereign nations that sets standards to calculate, verify and publicly report greenhouse gas emissions into a single public registry. The Registry supports both voluntary and state-mandated reporting programs and provides data regarding greenhouse gas emissions.[24]

The Carbon Disclosure Project collects and distributes climate change information, both quantitative (emissions amounts) and qualitative (risks and opportunities), on behalf of 475 institutional investors.[25] Over 2500 companies globally reported to the Carbon Disclosure Project in 2009; over 500 of those companies were U.S. companies. Sixty-eight percent of the companies that responded to the Carbon Disclosure Project's investor requests for information made their reports available to the public.[26]

The Global Reporting Initiative has developed a widely used sustainability reporting framework.[27] That framework is developed by GRI participants drawn from business, labor and professional institutions worldwide. The GRI framework sets out principles and indicators that organizations can use to measure and report their economic, environmental, and social performance, including issues involving climate change. Sustainability reports based on the GRI framework are used to benchmark performance with respect to laws, norms, codes, performance standards and voluntary initiatives, demonstrate organizational commitment to sustainable development, and compare organizational performance over time.

These and other reporting mechanisms can provide important information to investors outside of disclosure documents filed with the Commission. Although much of this reporting is provided voluntarily, registrants should be aware that some of the information they may be reporting pursuant to these mechanisms also may be required to be disclosed in filings made with the Commission pursuant to existing disclosure requirements.

II. Historical Background of SEC Environmental Disclosure

The Commission first addressed disclosure of material environmental issues in the early 1970s. The Commission issued an interpretive release stating that registrants should consider disclosing in their SEC filings the financial impact of compliance with environmental laws, based on the materiality of the information.[28] Throughout the 1970s, the Commission continued to explore the need for specific rules mandating disclosure of information relating to litigation and other business costs arising out of compliance with federal, state and local laws that regulate the discharge of materials into the environment or otherwise relate to the protection of the environment. These topics were the subject of several rulemaking efforts, extensive litigation, and public hearings, all of which resulted in the rules that now specifically address disclosure of environmental issues.[29] The Commission adopted these rules, which we discuss below, in final and current form in 1982, after a decade of evaluation and experience with the subject matter.[30]

Earlier, beginning in 1968, we began to develop and fine-tune our requirements for management to discuss and analyze their company's financial condition and results of operations in disclosure documents filed with the Commission.[31] During the 1970s and 1980s, materiality standards for disclosure under the federal securities laws also were more fully articulated.[32] Those standards provide that

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Housing, and Urban Development held a hearing on corporate disclosure of climate-related issues on October 31, 2007; representatives of signatories to the September 19, 2007 petition, among others, testified in that hearing. *See* "Climate Disclosure: Measuring Financial Risks and Opportunities," available at *http://banking.senate.gov/public/index.cfm?FuseAction=Hearings.Hearing&Hearing_ID=ed7a4968-1019-411d-9a22-c193c6b689ea*. Following the hearing, Senators Christopher Dodd and Jack Reed wrote to Chairman Christopher Cox urging the Commission to issue guidance regarding climate disclosure. *See http://dodd.senate.gov/multimedia/2007/120607_CoxLetter.pdf*.

[21] For information about the settlement agreements, *see* the New York Attorney General's Office press releases relating to: Xcel Energy, available at *http://www.oag.state.ny.us/media_center/2008/aug/aug27a_08.html*; Dynegy Inc., available at *http://www.oag.state.ny.us/media_center/2008/oct/oct23a_08.html*; and AES Corporation, available at *http://www.oag.state.ny.us/media_center/2009/nov/nov19a_09.html*.

[22] For example, in the electric utility industry, we have been informed by the Edison Electric Institute that 95% of the member companies it recently surveyed reported that they included at least some disclosure related to greenhouse gas emissions in their SEC filings, with 34% discussing quantities of greenhouse gases emitted and 23% discussing costs of climate-related compliance. Registrants include this type of disclosure in the risk factors, business description, legal proceedings, executive compensation, MD&A and financial statements sections of their annual reports. The Edison Electric Institute is an association of U.S. shareholder-owned electric companies. Their members serve 95 percent of the customers in the shareholder-owned segment of the industry, and represent approximately 70 percent of the U.S. electric power industry. The EEI also has more than 80 international electric companies as affiliate members, and nearly 200 industry suppliers and related organizations as associate members. The EEI described the results of its survey in a presentation to staff members of the Division of Corporation Finance.

[23] State requirements include CO_2 emissions disclosure requirements for electricity providers, greenhouse gas registries for reporting of entity emissions levels and emissions changes, and required reporting of greenhouse gas emissions. For a discussion of specific state requirements, *see http://epa.gov/climatechange/wycd/stateandlocalgov/state_reporting.html*.

[24] The Climate Registry's Web site is at www.theclimateregistry.org. Reports are publicly available through their Web site at no charge. *See http://www.theclimateregistry.org/resources/climate-registry-information-system-cris/public-reports/*.

[25] The Carbon Disclosure Project's Web site is at *http://www.cdproject.net*.

[26] These figures were provided to the Commission staff by representatives of the Carbon Disclosure Project.

[27] The GRI's Web site is at *http://www.globalreporting.org*.

[28] Release No. 33–5170 (July 19, 1971) [36 FR 13989].

[29] *See* Interpretive Release No. 33–6130 (September 27, 1979) [44 FR 56924] (the "1979 Release"), which includes a brief summary of the legal and administrative actions taken with regard to environmental disclosure during the 1970s. More information relating to the Commission's efforts in this area is chronicled in Release No. 33–6315 (May 4, 1981) [46 FR 25638].

[30] Release No. 33–6383 (March 3, 1982) [47 FR 11380].

[31] *See* Release No. 33–6835 (May 18, 1989) [54 FR 22427] (the "1989 Release") and Release No. 33–8350 (December 19, 2003) [68 FR 75055] (the "2003 Release") for detailed histories of Commission releases that outline the background of, and interpret, our MD&A rules.

[32] *See TSC Industries, Inc.* v. *Northway, Inc.*, 426 U.S. 438 (1976) (adopting a standard for materiality in connection with proxy statement disclosures supported by the Commission, *see id.* at n. 10) and *Basic Inc.* v. *Levinson*, 485 U.S. 224 (1988).

information is material if there is a substantial likelihood that a reasonable investor would consider it important in deciding how to vote or make an investment decision, or, put another way, if the information would alter the total mix of available information.[33] In the articulation of the materiality standards, it was recognized that doubts as to materiality of information would be commonplace, but that, particularly in view of the prophylactic purpose of the securities laws and the fact that disclosure is within management's control, "it is appropriate that these doubts be resolved in favor of those the statute is designed to protect."[34] With these developments, registrants had clearer guidance about what they should disclose in their filings.

More recently, the Commission reviewed its full disclosure program relating to environmental disclosures in SEC filings in connection with a Government Accountability Office review.[35] The Commission also has had the opportunity to consider the thoughtful suggestions that many organizations have provided us recently about how the Commission could direct registrants to enhance their disclosure about climate change related matters.[36]

III. Overview of Rules Requiring Disclosure of Climate Change Issues

When a registrant is required to file a disclosure document with the Commission, the requisite form will largely refer to the disclosure requirements of Regulation S–K[37] and Regulation S–X.[38] Securities Act Rule 408 and Exchange Act Rule 12b–20 require a registrant to disclose, in addition to the information expressly required by Commission regulation, "such further material information, if any, as may be necessary to make the required statements, in light of the circumstances under which they are made, not misleading."[39] In this section, we briefly describe the most pertinent non-financial statement disclosure rules that may require disclosure related to climate change; in the following section, we discuss their application to disclosure of certain specific climate change related matters.

A. Description of Business

Item 101 of Regulation S–K requires a registrant to describe its business and that of its subsidiaries. The Item lists a variety of topics that a registrant must address in its disclosure documents, including disclosure about its form of organization, principal products and services, major customers, and competitive conditions. The disclosure requirements cover the registrant and, in many cases, each reportable segment about which financial information is presented in the financial statements. If the information is material to individual segments of the business, a registrant must identify the affected segments.

Item 101 expressly requires disclosure regarding certain costs of complying with environmental laws.[40] In particular, Item 101(c)(1)(xii) states:

> Appropriate disclosure also shall be made as to the material effects that compliance with Federal, State and local provisions which have been enacted or adopted regulating the discharge of materials into the environment, or otherwise relating to the protection of the environment, may have upon the capital expenditures, earnings and competitive position of the registrant and its subsidiaries. The registrant shall disclose any material estimated capital expenditures for environmental control facilities for the remainder of its current fiscal year and its succeeding fiscal year and for such further periods as the registrant may deem material.[41]

A registrant meeting the definition of "smaller reporting company" may satisfy its disclosure obligation by providing information called for by Item 101(h). Item 101(h)(4)(xi) requires disclosure of the "costs and effects of compliance with environmental laws (federal, state and local)."[42]

B. Legal Proceedings

Item 103 of Regulation S–K[43] requires a registrant to briefly describe any material pending legal proceeding to which it or any of its subsidiaries is a party. A registrant also must describe material pending legal actions in which its property is the subject of the litigation.[44] If a registrant is aware of similar actions contemplated by governmental authorities, Item 103 requires disclosure of those proceedings as well. A registrant need not disclose ordinary routine litigation incidental to its business or other types of proceedings when the amount in controversy is below thresholds designated in this Item.

Instruction 5 to Item 103 provides some specific requirements that apply to disclosure of certain environmental litigation.[45] Instruction 5 states:

> Notwithstanding the foregoing, an administrative or judicial proceeding (including, for purposes of A and B of this Instruction, proceedings which present in large degree the same issues) arising under any Federal, State or local provisions that have been enacted or adopted regulating the discharge of materials into the environment or primary for the purpose of protecting the environment shall not be deemed "ordinary routine litigation incidental to the business" and shall be described if:
>
> (A) Such proceeding is material to the business or financial condition of the registrant;

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[33] *Basic* at 231, quoting *TSC Industries* at 449.

[34] *TSC Industries* at 448.

[35] "Environmental Disclosure: SEC Should Explore Ways to Improve Tracking and Transparency of Information," United States Government Accountability Office Report to Congressional Requesters, GAO–04–808 (July 2004). Eleven years before, at the request of the Chairman of the House Committee on Energy and Commerce, the GAO had prepared a report relating to environmental liability disclosure involving property and casualty insurers and Superfund cleanup costs. *See* "Environmental Liability: Property and Casualty Insurer Disclosure of Environmental Liabilities," GAO/RCED–93–108 (June 1993), available at *http://74.125.93.132/search?q=cache:tWeHLDHoIcUJ:www.gao.gov/cgi-bin/getrpt%3FGAO/RCED-93-108+GAO/RCED-93-108&cd=1&hl=en&ct=clnk&gl=us*.

[36] *See* n. 20, *supra*.

[37] 17 CFR Part 229.

[38] 17 CFR Part 210.

[39] 17 CFR 230.408 and 17 CFR 240.12b–20.

[40] The Commission first addressed disclosure of material costs and other effects on business resulting from compliance with existing environmental law in its first environmental disclosure interpretive release in 1971. *See* Release 33–5170 (July 19, 1971) [36 FR 13989]. The Commission codified that interpretive position in the disclosure forms two years later. *See* Release 33–5386 (April 20, 1973) [38 FR 12100]. The Commission provided additional interpretive guidance in the 1979 Release. With some adjustments to reflect experience with the subject matter, the requirements were moved to Item 101 in 1982, and they have not changed since that time. *See* Release No. 33–6383 (March 3, 1982) [47 FR 11380].

[41] 17 CFR 229.101(c)(1)(xii).

[42] 17 CFR 229.101(h)(4)(xi).

[43] 17 CFR 229.103.

[44] *Id.*

[45] Instruction 5 in its current form was the product of the Commission's experience with environmental litigation disclosure. In 1973, we added provisions to the legal proceedings requirements of various disclosure forms singling out legal actions involving environmental matters. *See* Release No. 33–5386 (Apr. 20, 1973) [38 FR 12100]. The new rules required disclosure of any pending legal proceeding arising under environmental laws if a governmental entity was involved in the proceeding, and any other legal proceeding arising under environmental laws unless it was not material, or if in a civil suit for damages, unless it involved less than 10% of the current assets of the registrant on a consolidated basis. The Commission provided additional interpretive guidance regarding environmental litigation in the 1979 Release. When the Commission, in connection with its development of the integrated disclosure system, moved these rules out of various forms and into Item 103 of Regulation S–K, the Commission modified the requirements related to actions involving governmental authorities to allow registrants to omit disclosure of a proceeding if they reasonably believed the action would result in a monetary sanction of less than $100,000. *See* Release No. 33–6383 (Mar. 3, 1982) [47 FR 11380]. At the time, the Commission noted that the reason for the revision was to address the problem that disclosure documents were being filled with descriptions of minor infractions that distracted from the other material disclosures included in the document.

(B) Such proceeding involves primarily a claim for damages, or involves potential monetary sanctions, capital expenditures, deferred charges or charges to income and the amount involved, exclusive of interest and costs, exceeds 10 percent of the current assets of the registrant and its subsidiaries on a consolidated basis; or

(C) A governmental authority is a party to such proceeding and such proceeding involves potential monetary sanctions, unless the registrant reasonably believes that such proceeding will result in no monetary sanctions, or in monetary sanctions, exclusive of interest and costs, of less than $100,000; provided, however, that such proceedings which are similar in nature may be grouped and described generically.

C. Risk Factors

Item 503(c) of Regulation S–K [46] requires a registrant to provide where appropriate, under the heading "Risk Factors," a discussion of the most significant factors that make an investment in the registrant speculative or risky. Item 503(c) specifies that risk factor disclosure should clearly state the risk and specify how the particular risk affects the particular registrant; registrants should not present risks that could apply to any issuer or any offering.[47]

D. Management's Discussion and Analysis

Item 303 of Regulation S–K [48] requires disclosure known as the Management's Discussion and Analysis of Financial Condition and Results of Operations, or MD&A. The MD&A requirements are intended to satisfy three principal objectives:

- To provide a narrative explanation of a registrant's financial statements that enables investors to see the registrant through the eyes of management;
- To enhance the overall financial disclosure and provide the context within which financial information should be analyzed; and
- To provide information about the quality of, and potential variability of, a registrant's earnings and cash flow, so that investors can ascertain the likelihood that past performance is indicative of future performance.[49]

MD&A disclosure should provide material historical and prospective textual disclosure enabling investors to assess the financial condition and results of operations of the registrant, with particular emphasis on the registrant's prospects for the future.[50] Some of this information is itself non-financial in nature, but bears on registrants' financial condition and operating performance.

The Commission has issued several releases providing guidance on MD&A disclosure, including on the general requirements of the item and its application to specific disclosure matters.[51] Over the years, the flexible nature of this requirement has resulted in disclosures that keep pace with the evolving nature of business trends without the need to continuously amend the text of the rule. Nevertheless, we and our staff continue to have to remind registrants, through comments issued in the filing review process, public statements by staff and Commissioners and otherwise, that the disclosure provided in response to this requirement should be clear and communicate to shareholders management's view of the company's financial condition and prospects.[52]

Item 303 includes a broad range of disclosure items that address the registrant's liquidity, capital resources and results of operations. Some of these provisions, such as the requirement to provide tabular disclosure of contractual obligations,[53] clearly specify the disclosure required for compliance. But others instead identify principles and require management to apply the principles in the context of the registrant's particular circumstances. For example, registrants must identify and disclose known trends, events, demands, commitments and uncertainties that are reasonably likely [54] to have a material effect on financial condition or operating performance. This disclosure should highlight issues that are reasonably likely to cause reported financial information not to be necessarily indicative of future operating performance or of future financial condition.[55] Disclosure decisions concerning trends, demands, commitments, events, and uncertainties generally should involve the:

- Consideration of financial, operational and other information known to the registrant;
- Identification, based on this information, of known trends and uncertainties; and
- Assessment of whether these trends and uncertainties will have, or are reasonably likely to have, a material impact on the registrant's liquidity, capital resources or results of operations.[56]

The Commission has not quantified, in Item 303 or otherwise, a specific future time period that must be considered in assessing the impact of a known trend, event or uncertainty that is reasonably likely to occur. As with any other judgment required by Item 303, the necessary time period will depend on a registrant's particular circumstances and the particular trend, event or uncertainty under consideration. For example, a registrant considering its disclosure obligation with respect to its liquidity needs would have to consider the duration of its known capital requirements and the periods over which cash flows are managed in determining the time period of its disclosure regarding future capital sources.[57] In addition, the time horizon of a known trend, event or uncertainty may be relevant to a registrant's assessment of the materiality of the matter and whether or not the impact is reasonably likely. As with respect to other subjects of disclosure, materiality "with respect to contingent or speculative information or events * * * 'will depend at any given time upon a balancing of both the indicated probability that the event will occur and the anticipated magnitude of the event in light of the totality of the company activity.'" [58]

The nature of certain MD&A disclosure requirements places particular importance on a registrant's materiality determinations. The Commission has recognized that the effectiveness of MD&A decreases with the accumulation of unnecessary detail or duplicative or uninformative disclosure that obscures material information.[59] Registrants drafting MD&A disclosure should focus on material information and eliminate immaterial information that does not promote understanding of registrants' financial condition, liquidity and capital resources, changes in financial condition and results of operations.[60] While these materiality determinations may limit what is actually disclosed,

[46] 17 CFR 229.503(c).

[47] *Id.*

[48] 17 CFR 229.303.

[49] 2003 Release.

[50] 1989 Release.

[51] *See, e.g.*, the 2003 Release; Release No. 33–8182 (Jan. 28, 2003) [68 FR 5982]; Release No. 33–8056 (Jan. 22, 2002) [67 FR 3746]; Release. No. 33–7558 (Jul. 29, 1998) [63 FR 41394]; and 1989 Release.

[52] *See, e.g.*, speech by Commissioner Cynthia A. Glassman to the Corporate Counsel Institute (Mar. 9, 2006) available at *www.sec.gov/news/speech/spch030906cag.htm*; and speech by Commissioner Elisse B. Walter to the Corporate Counsel Institute (Oct. 2, 2009) available at *www.sec.gov/news/speech/2009/spch100209ebw.htm*.

[53] 17 CFR 229.303(a)(5).

[54] "Reasonably likely" is a lower disclosure standard than "more likely than not." Release No. 33–8056 (Jan. 22, 2002) [67 FR 3746].

[55] 2003 Release.

[56] *Id.*

[57] *Id.* at n.43.

[58] *Basic* at 238, quoting *Texas Gulf Sulfur Co.,* 401 F. 2d 833 (2d Cir. 1968) at 849.

[59] 2003 Release.

[60] *Id.*

they should not limit the information that management considers in making its determinations. Improvements in technology and communications in the last two decades have significantly increased the amount of financial and non-financial information that management has and should evaluate, as well as the speed with which management receives and is able to use information. While this should not necessarily result in increased MD&A disclosure, it does provide more information that may need to be considered in drafting MD&A disclosure. In identifying, discussing and analyzing known material trends and uncertainties, registrants are expected to consider all relevant information even if that information is not required to be disclosed,[61] and, as with any other disclosure judgments, they should consider whether they have sufficient disclosure controls and procedures to process this information.[62]

Analyzing the materiality of known trends, events or uncertainties may be particularly challenging for registrants preparing MD&A disclosure. As the Commission explained in the 1989 Release, when a trend, demand, commitment, event or uncertainty is known, "management must make two assessments:

- Is the known trend, demand, commitment, event or uncertainty likely to come to fruition? If management determines that it is not reasonably likely to occur, no disclosure is required.
- If management cannot make that determination, it must evaluate objectively the consequences of the known trend, demand, commitment, event or uncertainty, on the assumption that it will come to fruition. Disclosure is then required unless management determines that a material effect on the registrant's financial condition or results of operations is not reasonably likely to occur."[63]

Identifying and assessing known material trends and uncertainties generally will require registrants to consider a substantial amount of financial and non-financial information available to them, including information that itself may not be required to be disclosed.[64]

Registrants should address, when material, the difficulties involved in assessing the effect of the amount and timing of uncertain events, and provide an indication of the time periods in which resolution of the uncertainties is anticipated.[65] In accordance with Item 303(a), registrants must also disclose any other information a registrant believes is necessary to an understanding of its financial condition, changes in financial condition and results of operations.

E. Foreign Private Issuers

The Securities Act and Exchange Act disclosure obligations of foreign private issuers are governed principally by Form 20–F's[66] disclosure requirements and not those under Regulation S–K. However, most of the disclosure requirements applicable to domestic issuers under Regulation S–K that are most likely to require disclosure related to climate change have parallels under Form 20–F, although some of the requirements are not as prescriptive as the provisions applicable to domestic issuers. For example, the following provisions of Form 20–F may require a foreign private issuer to provide disclosure concerning climate change matters that are material to its business:

- Item 3.D, which requires a foreign private issuer to disclose its material risks;
- Item 4.B.8, which requires a foreign private issuer to describe the material effects of government regulation on its business and to identify the particular regulatory body;
- Item 4.D, which requires a foreign private issuer to describe any environmental issues that may affect the company's utilization of its assets;
- Item 5, which requires management's explanation of factors that have affected the company's financial condition and results of operations for the historical periods covered by the financial statements, and management's assessment of factors and trends that are anticipated to have a material effect on the company's financial condition and results of operations in future periods; and
- Item 8.A.7, which requires a foreign private issuer to provide information on any legal or arbitration proceedings, including governmental proceedings, which may have, or have had in the recent past, significant effects on the company's financial position or profitability.

Forms F–1[67] and F–3,[68] Securities Act registration statement forms for foreign private issuers, also require a foreign private issuer to provide the information, including risk factor disclosure, required under Regulation S–K Item 503.

IV. Climate Change Related Disclosures

In the previous section we summarized a number of Commission rules and regulations that may be the source of a disclosure obligation for registrants under the federal securities laws. Depending on the facts and circumstances of a particular registrant, each of the items discussed above may require disclosure regarding the impact of climate change. The following topics are some of the ways climate change may trigger disclosure required by these rules and regulations.[69] These topics are examples of climate change related issues that a registrant may need to consider.

A. Impact of Legislation and Regulation

As discussed above, there have been significant developments in federal and state legislation and regulation regarding climate change. These developments may trigger disclosure obligations under Commission rules and regulations, such as pursuant to Items 101, 103, 503(c) and 303 of Regulation S–K. With respect to existing federal, state and local provisions which relate to greenhouse gas emissions, Item 101 requires disclosure of any material estimated capital expenditures for environmental control facilities for the remainder of a registrant's current fiscal year and its succeeding fiscal year and

[61] *Id.*

[62] Pursuant to Exchange Act Rules 13a–15 and 15d–15, a company's principal executive officer and principal financial officer must make certifications regarding the maintenance and effectiveness of disclosure controls and procedures. These rules define "disclosure controls and procedures" as those controls and procedures designed to ensure that information required to be disclosed by the company in the reports that it files or submits under the Exchange Act is (1) "recorded, processed, summarized and reported, within the time periods specified in the Commission's rules and forms," and (2) "accumulated and communicated to the company's management * * * as appropriate to allow timely decisions regarding required disclosure." As we have stated before, a company's disclosure controls and procedures should not be limited to disclosure specifically required, but should also ensure timely collection and evaluation of "information potentially subject to [required] disclosure," "information that is relevant to an assessment of the need to disclose developments and risks that pertain to the [company's] businesses," and "information that must be evaluated in the context of the disclosure requirement of Exchange Act Rule 12b–20." Release No. 33–8124 (Aug. 28, 2002) [67 FR 57276].

[63] 1989 Release.

[64] 2003 Release.

[65] *Id.*

[66] 17 CFR 249.220f.

[67] 17 CFR 239.31.

[68] 17 CFR 239.33.

[69] In addition to the Regulation S–K items discussed in this section, registrants must also consider any financial statement implications of climate change issues in accordance with applicable accounting standards, including Financial Accounting Standards Board ("FASB") Accounting Standards Codification Topic 450, Contingencies, and FASB Accounting Standards Codification Topic 275, Risks and Uncertainties.

for such further periods as the registrant may deem material. Depending on a registrant's particular circumstances, Item 503(c) may require risk factor disclosure regarding existing or pending legislation or regulation that relates to climate change. Registrants should consider specific risks they face as a result of climate change legislation or regulation and avoid generic risk factor disclosure that could apply to any company. For example, registrants that are particularly sensitive to greenhouse gas legislation or regulation, such as registrants in the energy sector, may face significantly different risks from climate change legislation or regulation compared to registrants that currently are reliant on products that emit greenhouse gases, such as registrants in the transportation sector.

Item 303 requires registrants to assess whether any enacted climate change legislation or regulation is reasonably likely to have a material effect on the registrant's financial condition or results of operation.[70] In the case of a known uncertainty, such as pending legislation or regulation, the analysis of whether disclosure is required in MD&A consists of two steps. First, management must evaluate whether the pending legislation or regulation is reasonably likely to be enacted. Unless management determines that it is not reasonably likely to be enacted, it must proceed on the assumption that the legislation or regulation will be enacted. Second, management must determine whether the legislation or regulation, if enacted, is reasonably likely to have a material effect on the registrant, its financial condition or results of operations. Unless management determines that a material effect is not reasonably likely,[71] MD&A disclosure is required.[72] In addition to disclosing the potential effect of pending legislation or regulation, the registrant would also have to consider disclosure, if material, of the difficulties involved in assessing the timing and effect of the pending legislation or regulation.[73]

A registrant should not limit its evaluation of disclosure of a proposed law only to negative consequences. Changes in the law or in the business practices of some registrants in response to the law may provide new opportunities for registrants. For example, if a "cap and trade" type system is put in place, registrants may be able to profit from the sale of allowances if their emissions levels end up being below their emissions allotment. Likewise, those who are not covered by statutory emissions caps may be able to profit by selling offset credits they may qualify for under new legislation.

Examples of possible consequences of pending legislation and regulation related to climate change include:

- Costs to purchase, or profits from sales of, allowances or credits under a "cap and trade" system;
- Costs required to improve facilities and equipment to reduce emissions in order to comply with regulatory limits or to mitigate the financial consequences of a "cap and trade" regime; and
- Changes to profit or loss arising from increased or decreased demand for goods and services produced by the registrant arising directly from legislation or regulation, and indirectly from changes in costs of goods sold.

We reiterate that climate change regulation is a rapidly developing area. Registrants need to regularly assess their potential disclosure obligations given new developments.

B. International Accord

Registrants also should consider, and disclose when material, the impact on their business of treaties or international accords relating to climate change. We already have noted the Kyoto Protocol, the EU ETS and other international activities in connection with climate change remediation. The potential sources of disclosure obligations related to international accords are the same as those discussed above for U.S. climate change regulation. Registrants whose businesses are reasonably likely to be affected by such agreements should monitor the progress of any potential agreements and consider the possible impact in satisfying their disclosure obligations based on the MD&A and materiality principles previously outlined.

C. Indirect Consequences of Regulation or Business Trends

Legal, technological, political and scientific developments regarding climate change may create new opportunities or risks for registrants. These developments may create demand for new products or services, or decrease demand for existing products or services. For example, possible indirect consequences or opportunities may include:

- Decreased demand for goods that produce significant greenhouse gas emissions;
- Increased demand for goods that result in lower emissions than competing products;[74]
- Increased competition to develop innovative new products;
- Increased demand for generation and transmission of energy from alternative energy sources; and
- Decreased demand for services related to carbon based energy sources, such as drilling services or equipment maintenance services.

These business trends or risks may be required to be disclosed as risk factors or in MD&A. In some cases, these developments could have a significant enough impact on a registrant's business that disclosure may be required in its business description under Item 101. For example, a registrant that plans to reposition itself to take advantage of potential opportunities, such as through material acquisitions of plants or equipment, may be required by Item 101(a)(1) to disclose this shift in plan of operation. Registrants should consider their own particular facts and circumstances in evaluating the materiality of these opportunities and obligations.

Another example of a potential indirect risk from climate change that would need to be considered for risk factor disclosure is the impact on a registrant's reputation. Depending on the nature of a registrant's business and its sensitivity to public opinion, a registrant may have to consider whether the public's perception of any publicly available data relating to its greenhouse gas emissions could expose it to potential adverse consequences to its business operations or financial condition resulting from reputational damage.

D. Physical Impacts of Climate Change

Significant physical effects of climate change, such as effects on the severity of weather (for example, floods or hurricanes), sea levels, the arability of farmland, and water availability and

[70] *See* 1989 Release.

[71] Management should ensure that it has sufficient information regarding the registrant's greenhouse gas emissions and other operational matters to evaluate the likelihood of a material effect arising from the subject legislation or regulation. *See* n. 62, *supra*.

[72] In 2003 we issued additional guidance with respect to how registrants could improve MD&A disclosure, including ideas about how to focus on material issues and how to present information in a more effective manner to be of more value to investors. *See* 2003 Release.

[73] *See* 2003 Release for a discussion of how companies should address, where material, the difficulties involved in assessing the effect of the amount and timing of uncertain events.

[74] For example, recent legislation will ultimately phase out most traditional incandescent light bulbs. This has resulted in the acceleration of the development and marketing of compact fluorescent light bulbs. *See* Energy Independence and Security Act of 2007, Public Law 110–140, 121 Stat. 1492 (2007).

quality,[75] have the potential to affect a registrant's operations and results. For example, severe weather can cause catastrophic harm to physical plants and facilities and can disrupt manufacturing and distribution processes. A 2007 Government Accountability Office report states that 88% of all property losses paid by insurers between 1980 and 2005 were weather-related.[76] As noted in the GAO report, severe weather can have a devastating effect on the financial condition of affected businesses. The GAO report cites a number of sources to support the view that severe weather scenarios will increase as a result of climate change brought on by an overabundance of greenhouse gases.

Possible consequences of severe weather could include:

- For registrants with operations concentrated on coastlines, property damage and disruptions to operations, including manufacturing operations or the transport of manufactured products;
- Indirect financial and operational impacts from disruptions to the operations of major customers or suppliers from severe weather, such as hurricanes or floods;
- Increased insurance claims and liabilities for insurance and reinsurance companies ;[77]
- Decreased agricultural production capacity in areas affected by drought or other weather-related changes; and
- Increased insurance premiums and deductibles, or a decrease in the availability of coverage, for registrants with plants or operations in areas subject to severe weather.

Registrants whose businesses may be vulnerable to severe weather or climate related events should consider disclosing material risks of, or consequences from, such events in their publicly filed disclosure documents.

V. Conclusion

This interpretive release is intended to remind companies of their obligations under existing federal securities laws and regulations to consider climate change and its consequences as they prepare disclosure documents to be filed with us and provided to investors. We will monitor the impact of this interpretive release on company filings as part of our ongoing disclosure review program. In addition, the Commission's Investor Advisory Committee[78] is considering climate change disclosure issues as part of its overall mandate to provide advice and recommendations to the Commission, and the Commission is planning to hold a public roundtable on disclosure regarding climate change matters in the spring of 2010. We will consider our experience with the disclosure review program together with any advice or recommendations made to us by the Investor Advisory Committee and information gained through the planned roundtable as we determine whether further guidance or rulemaking relating to climate change disclosure is necessary or appropriate in the public interest or for the protection of investors.

VI. Codification Update

The "Codification of Financial Reporting Policies" announced in Financial Reporting Release No. 1 (April 15, 1982) [47 FR 21028] is updated by adding new Section 501.15, captioned "Climate change related disclosures," and under that caption including the text in Sections III and IV of this release.

The Codification is a separate publication of the Commission. It will not be published in the **Federal Register**/Code of Federal Regulations.

List of Subjects

17 CFR Part 211

Reporting and recordkeeping requirements, Securities.

17 CFR Parts 231 and 241

Securities.

Amendments to the Code of Federal Regulations

■ For the reasons set forth above, the Commission is amending Title 17, Chapter II of the Code of Federal Regulations as set forth below:

PART 211—INTERPRETATIONS RELATING TO FINANCIAL REPORTING MATTERS

■ 1. Part 211, Subpart A, is amended by adding Release No. FR–82 and the release date of February 2, 2010 to the list of interpretive releases.

PART 231—INTERPRETATIVE RELEASES RELATING TO THE SECURITIES ACT OF 1933 AND GENERAL RULES AND REGULATIONS THEREUNDER

■ 2. Part 231 is amended by adding Release No. 33–9106 and the release date of February 2, 2010 to the list of interpretive releases.

PART 241—INTERPRETATIVE RELEASES RELATING TO THE SECURITIES EXCHANGE ACT OF 1934 AND GENERAL RULES AND REGULATIONS THEREUNDER

■ 3. Part 241 is amended by adding Release No. 34–61469 and the release date of February 2, 2010 to the list of interpretive releases.

By the Commission.

Dated: February 2, 2010.

Elizabeth M. Murphy,

Secretary.

[FR Doc. 2010–2602 Filed 2–5–10; 8:45 am]

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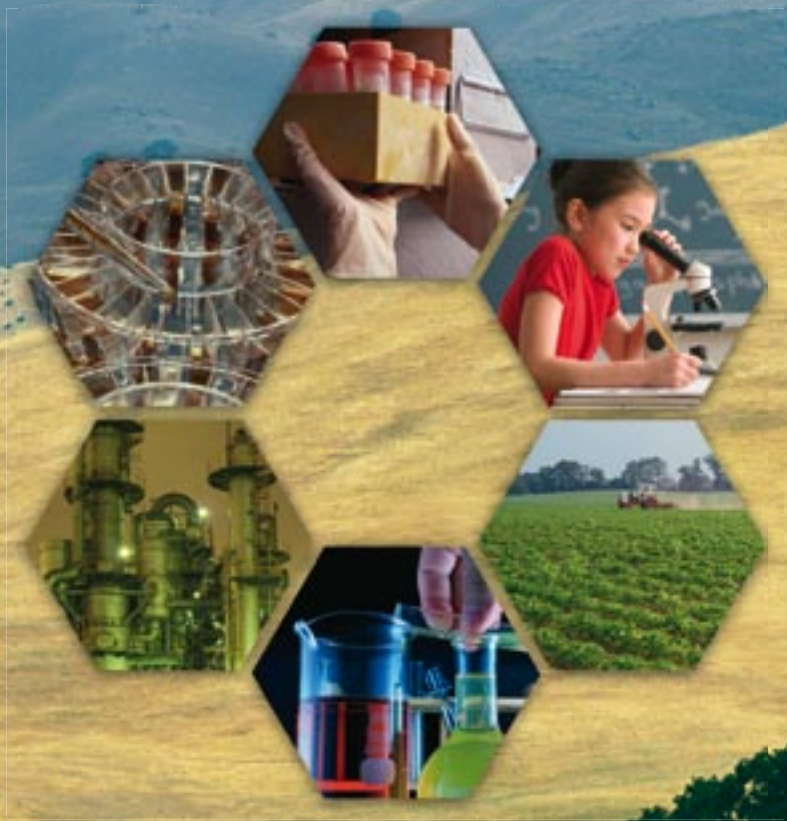
[75] *See* "Climate Change: Financial Risks to Federal and Private Insurers in Coming Decades Are Potentially Significant: U.S. Government Accountability Office Report to the Committee on Homeland Security and Governmental Affairs, U.S. Senate," GAO–07–285 (March 2007).

[76] *Id.* at p.17.

[77] Many insurers already have plans in place to address the increased risks that may arise as a result of climate change, with many reducing their near-term catastrophic exposure in both reinsurance and primary insurance coverage along the Gulf Coast and the eastern seaboard. *Id.* at 32.

[78] The Investor Advisory Committee was formed on June 3, 2009 to advise the Commission on matters of concern to investors in the securities markets, provide the Commission with investors' perspectives on current, non-enforcement, regulatory issues and serve as a source of information and recommendations to the Commission regarding the Commission's regulatory programs from the point of view of investors. *See* Press Release No. 2009–126, "SEC Announces Creation of Investor Advisory Committee," available at *http://www.sec.gov/news/press/2009/2009-126.htm.*



Towards 2020:
Making Chemicals Safer

The EU's contribution to the Strategic Approach to International Chemicals Management

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Table of Contents

INTRODUCTION

"*Achieve by 2020 that chemicals are used and produced in ways that lead to the minimisation of significant adverse effects on human health and the environment.*"

(World Summit on Sustainable Development, Johannesburg, 2002)

We live in a society that is dependent on chemicals. From the production of the food we eat to health, personal care or household products, we come into contact with chemicals on a daily basis.

While many of these contribute to our comfort, some chemicals can severely damage our health or our environment and in particular our immune, nervous or reproductive systems. Others could be dangerous if not used properly.

A growing global awareness of the potential harm to human health and the environment caused by exposure to chemicals, led the World Summit on Sustainable Development (WSSD), held in Johannesburg in 2002, to make a global political commitment to sound chemicals management by 2020. International efforts to realise the goal resulted in the adoption of the Strategic Approach to International Chemicals Management (SAICM), by the United Nations Environment Programme in February 2006.

The 2020 goal was fundamental in overhauling chemicals legislation in the European Union. The past decade has witnessed a revolution in EU chemicals policy. Under old chemical legislation there was insufficient information about existing substances and their adverse effects. After a long and broad consultative process, the EU adopted a new chemicals law, known as REACH, to close this information gap. REACH sets new standards in chemicals legislation and places the burden of proof on industry to ensure that chemicals are safe.

This brochure gives an overview of current EU legislation on different aspects of chemicals management and shows how SAICM principles are applied. It also showcases projects co-funded by the European Commission, EU Member States, NGOs and industry to promote them.

Sound chemicals management is essential to the sustainable development of all societies. Each country is responsible for ensuring the highest level of protection for its citizens and the environment. The European Commission is committed to playing its part in achieving chemical safety for citizens and the environment worldwide.

Stavros Dimas
European Commissioner for the Environment

MAIN EU CHEMICALS MANAGEMENT POLICIES

The EU and the Strategic Approach to International Chemicals Management

The European Union played a pivotal role in the launch of the Strategic Approach to International Chemicals Management (SAICM), which was developed and negotiated with the participation of a wide range of stakeholders from more than 140 countries. It was adopted by the United Nations Environment Programme's Governing Council in February 2006 in Dubai.

The SAICM Global Plan of Action sets out nearly 300 different activities that will help countries reach its overall objective of achieving the sound management of chemicals throughout their life-cycle so that, by 2020, they are used and produced in ways that reduce major adverse effects on health and the environment.

Strong emphasis is put on capacity-building – the development of institutions, policies, monitoring tools, training facilities, networks and data bases – and technical assistance to developing countries and countries with transition economies to help them manage chemicals safely. This will help close the gap between developing and developed nations in sound chemicals management.

A voluntary trust fund, known as the Quick Start Programme (QSP), was set up to mobilise money for the start-up phase and enable countries to start implementation, especially through capacity-building.

The EU is committed to SAICM and is actively implementing it through its policies and legislation, while also working with other countries to meet the 2020 goal.

REACH: a revolution in chemicals policy

With almost a third of the global market, the EU is one of the world's largest producers of chemicals. Until quite recently, EU chemical legislation was a patchwork of many different rules and regulations and insufficient information was available to assess and control chemical substances effectively.

Getty Images

The new EU chemicals policy REACH, concerning the Registration, Evaluation, Authorisation and restriction of Chemicals, which came into force on 1 June 2007, creates a single regulatory system for dealing with chemical substances. It seeks to close the knowledge gap that has existed so far and places greater responsibility on industry to manage the risk of chemicals and provide appropriate safety information to professional users. The new legislation also put obligations on industry to inform consumers about the presence of the most hazardous substances in products. The most dangerous chemicals will be phased out under REACH, which encourages the progressive replacement of dangerous chemicals with safer ones.

The information generated by REACH will provide input into this process and into many other pieces of legislation and REACH fulfils many SAICM principles, particularly those relating to knowledge and information on chemicals and chemicals management.

Registration

Each producer and importer of chemicals in volumes of 1 tonne or more per year must register them with the European Chemicals Agency (ECHA) and submit information on their properties, uses and safe ways of handling them. Those registering chemicals can use existing data and are obliged to share data. Producers and importers have to pass safety information on to those who use a substance in the course of their industrial or professional activities. This is to ensure they know how to use the substances without risks to workers, consumers and the environment.

Evaluation

The evaluation process enables public authorities to look in greater detail at registration dossiers and at substances of concern. The authorities can request more information if necessary. All proposals are scrutinised to limit animal testing to the absolute minimum. REACH makes data-sharing on animal test results compulsory and prescribes the use of alternative methods wherever possible.

Authorisation

Authorisation is required for uses of chemicals that cause cancer, mutations or problems with reproduction, or that accumulate in our bodies and the environment. Authorisation to use these chemicals, or chemicals raising an equivalent concern, will be granted only to companies that can show that the risks are adequately controlled or if the social and economic benefits outweigh the risks where no suitable alternative substances or technologies exist. The aim is to encourage progressive substitution – the replacement of the most dangerous chemicals with safer alternatives.

Restrictions

REACH will introduce clearer procedures for restricting the use of dangerous substances at EU level. A restriction or ban can be imposed on the manufacture, placing on the market or use of certain substances, where there is an unacceptable risk to health or the environment.

European Chemicals Agency (ECHA)

The European Chemicals Agency, which is based in Helsinki, was set up to manage the day-to-day operation of the registration, evaluation, authorisation and restriction processes of chemical substances. ECHA centralises the processing and storing of the registrations of chemical substances for the entire EU, as well as Norway, Iceland and Liechtenstein. ECHA also provides expert opinions to the European Commission in the authorisation and restriction processes required under the legislation.

Much of the information about the chemicals generated under REACH will be publicly available and can therefore also assist governments and other stakeholders in non-EU countries.

The European Commission is in contact with a large number of non-EU countries to help them with training and technical assistance concerning REACH requirements. REACH has the potential to inspire new standards worldwide, although it is for each country to decide whether the European approach is compatible with their specific circumstances.

Further information:
http://ec.europa.eu/environment/chemicals/reach/reach_intro.htm
http://ec.europa.eu/enterprise/reach/index_en.htm
http://echa.europa.eu/

Common rules on labelling and packaging

The chemical industry is a large source of employment worldwide. In the EU it employs around 1.2 million people in 29,000 chemicals producing companies. The companies that process substances and preparations also employ many thousands of workers. It is essential to protect these workers, as well as consumers and the environment, from the potential dangers of chemical substances.

Many countries have developed systems for providing information on hazardous properties and control measures aimed at ensuring their safe production, transport, use and disposal. However, those systems are not always compatible with each other and often require multiple labels and safety data sheets for the same product.

In December 2002, the United Nations adopted a system to provide criteria which ensure that the same hazards are described and labelled in the same way all around the world. The Globally Harmonised System of Classification and Labelling of Chemicals is a common approach for employees in the industry, emergency workers, those involved in transporting chemicals and the public.

New EU legislation on the classification, labelling and packaging of substances and mixtures (CLP), which came into force in January 2009, now follows the UN system. Companies will be required to classify, label and package hazardous chemicals (substances and mixtures) in accordance with the CLP legislation before placing them on the market. The European labelling provisions take on board the red-framed hazard pictograms, signal words, hazard and precautionary statements found in the UN Globally Harmonised System.

Further information:
http://ec.europa.eu/environment/chemicals/ghs/index_en.htm
http://ec.europa.eu/enterprise/reach/index_en.htm

Dealing with waste

As European society has grown wealthier it has created more and more waste. Each year in the European Union 1.3 billion tonnes of waste are thrown away. Some 40 million tonnes of this is hazardous. This requires specific legislation on chemical waste.

Hazardous waste

Hazardous waste poses a greater risk to the environment and human health than non-hazardous waste and requires a stricter control regime. The classification of hazardous and non-hazardous waste is based on the system for the classification and labelling of dangerous substances and mixtures, which ensures the application of similar principles over the whole life cycle of waste.

EU law imposes record keeping on hazardous waste for each stakeholder in the waste management chain, from the waste producer to the final disposal. The law also provides that hazardous waste is not diluted or mixed together or with other waste or materials, to prevent harming the environment and the public. EU Member States have monitoring and inspection obligations for the proper application of this legislation.

The export of hazardous waste to non-OECD countries is prohibited by EU legislation on shipments of waste.

Further information:
http://ec.europa.eu/environment/waste/hazardous_index.htm

Electrical and electronic waste

EU legislation restricting the use of hazardous substances in electrical and electronic equipment and promoting the collection and recycling of such equipment has been in force since February 2003. The legislation sets out rules for the creation of collection schemes where consumers return their used e-waste free of charge. The objective is to prevent waste and increase the collection, recycling and/or re-use of such products. The legislation also bans heavy metals such as lead, mercury, cadmium, and chromium and flame retardants such as polybrominated biphenyls (PBB) or polybrominated diphenyl ethers (PBDE) to avoid the dangers of hazardous substances leaking into the environment and/or contaminating materials for recycling.

Getty Images

EU laws have contributed to the reduction of environmental impacts from electronic appliances. Despite these rules, a significant amount of electrical and electronic waste is still potentially going to sub-standard treatment sites in or outside the European Union. The Illegal trade of electrical and electronic waste to non-EU countries continues to be widespread. The European Commission is proposing a revision of the directives on electrical and electronic equipment to reduce the negative environmental impacts of this fast increasing waste stream.

Further information:
http://ec.europa.eu/environment/waste/weee/index_en.htm

Safer ship dismantling

Every year between 200 and 600 large merchant ships are taken apart for their valuable scrap metal. Many of the ships taken out of service in Europe, end up being dismantled on beaches in South Asia. These older ships contain many hazardous materials, including asbestos, polychlorinated biphenyls (PCBs) and large quantities of oil.

The problem of ship dismantling is expected to get worse. The dismantling of single-hull oil tankers is predicted to peak over the next few years as they are phased out in favour of safer double-hulled vessels. Around 800 such tankers are expected to be taken out of service.

The lack of environmental protection and safety measures in place has resulted in many accidents, health problems and extensive pollution of wide stretches of the coast. The proposed EU strategy on better ship dismantling includes measures to implement key elements of an international convention on safe ship recycling that is due to be concluded by May 2009. It also proposes measures to encourage voluntary action by the shipping industry and better enforcement of current EU waste shipment law.

Further information:
http://ec.europa.eu/environment/waste/ships/index.htm

Action on mercury

Mercury and its compounds are highly toxic to humans, animals and ecosystems. High doses can be fatal to humans, but even relatively low doses can seriously affect the nervous system, and have recently been linked with possible harmful effects on the cardiovascular, immune and reproductive systems.

Mercury persists in the environment where it can change into methylmercury, its most toxic form. Methylmercury readily passes through both the placenta and the blood-brain barrier, making exposure of women of child-bearing age and children a great concern.

The use of mercury has declined globally and in the EU. Yet some significant uses remain. The main uses of mercury are in small-scale gold mining, the chlor-alkali industry and in some countries in the production of vinyl chloride monomer, the base of PVC plastic. In the EU, the chlor-alkali industry remains the most significant user, but it is progressively phasing out the use of mercury-containing cells in its production of chlorine and caustic soda. The next most significant use in the EU is in dental amalgam.

The EU has made considerable progress in addressing the global challenges of this toxic metal since it launched its mercury strategy in 2005. The aim of the strategy is to reduce mercury emissions, cut supply and demand and protect against exposure, especially exposure to methylmercury found in fish. This new approach has led to restrictions on the sale of thermometers and other measuring devices containing mercury, has banned exports of mercury from the EU from 2011, and has established new rules on storage.

The EU was one of the driving forces behind the global consensus reached in Nairobi in February 2009 to launch negotiations on an international legal agreement to control mercury.

Further information:
http://ec.europa.eu/environment/chemicals/mercury/index.htm

Pesticides

Under EU legislation, pesticides have usually been divided into two major groups: plant protection products, and biocides.

Plant protection products (PPPs) are mostly used in agriculture; however, PPPs are also used by the public in homes and gardens, local authorities and leisure developments.

While these may have the potential to kill or control harmful organisms such as pests, they can also cause unwanted adverse effects on non-target organisms, human health and the environment.

Current EU legislation covers the authorisation, control and to a lesser extent, use, of plant protection products. It lays down a comprehensive risk assessment and authorisation procedure for active substances and products containing these substances. Each active substance must be proven safe to humans – including residues in the food chain, animals and the environment – before it is allowed on the market.

To ensure greater protection for health and the environment, the legislation is being revised. While current controls concentrate on the beginning and end life stages of pesticides, new legislation will focus on the actual use stage of pesticides to ensure sustainability. In addition, it will strengthen rules for the placing of plant protection products on the market. Proposals for legislation concerning the collection of statistics on plant protection products and the introduction of an environmental protection requirement for machinery used to apply pesticides are also under discussion.

Further information:
http://ec.europa.eu/environment/ppps/home.htm


Getty Images

Biocides


Wikimedia

Biocides are a wide range of products used to control harmful organisms such as pests and germs. They include insect repellents, rat poison, disinfectants, and a number of industrial chemicals such as anti-fouling paints for ships and material preservatives.

They have been regulated under EU law since 1998. Over the past 10 years this has had positive results for the environment and human health, removing dangerous products like strychnine from the European market, and identifying all chemicals used as biocides. These chemicals are now being reviewed to ensure that they work, are safe, and do not harm the environment.

A revision of legislation proposes new rules on EU authorisations which will reduce costs for the approval of low risk products, such as those based on natural substances, or those that do not come into contact with people or the environment. They will also ensure that materials or articles, such as furniture, are treated only with biocidal products authorised for this use in the EU and that treated materials or articles are labelled, so that people, suffering from allergies for example, can avoid substances that may affect them.

Further information:
http://ec.europa.eu/environment/biocides/index.htm

Cosmetics

The EU regulates cosmetic products to ensure they are not harmful to consumers. Legislation sets out lists of substances which cannot be included in cosmetic products or which they may contain only under specific restrictions and conditions. To protect consumers and enable them to make informed choices, packaging must bear certain information, including a list of ingredients. The EU law on cosmetics is currently under revision, in order to ensure greater safety for consumers, while simplifying the rules and encouraging innovation. For the first time in the EU, the new legislation will include special rules on the use of nanomaterials.

Further information:
http://ec.europa.eu/enterprise/cosmetics/index_en.htm

Butterfly - © Migacz - Fotolia.com

Playing safe

Butterfly - © Migacz - Fotolia.com

Children's health and safety demands the highest possible protection. The EU is currently strengthening rules on toy safety, particularly those relating to the use of chemical substances. Chemicals that may cause cancer, mutations, or harm reproduction will no longer be allowed in accessible parts of toys. For certain substances like nickel, tolerable limits will be reduced and toxic heavy metals, such as mercury and lead will no longer be able to be intentionally used in toys. Fragrances will either be completely forbidden if they have strong allergenic potential or will have to be labelled as potentially allergenic to consumers.

Further information:
http://ec.europa.eu/enterprise/toys/2008_108_directive.htm

International treaties

As chemicals can travel long distances in the environment and are traded internationally, chemical safety is a global concern and has inspired a number of international initiatives. The European Union plays a leading role in all these initiatives and cooperates closely with non-EU countries.

They include the **Stockholm Convention on Persistent Organic Pollutants (POPs)**. POPs are chemical substances that build up in the environment and the food chain and pose health risks to humans and the environment. The Stockholm Convention currently targets 12 POPs. This group of priority pollutants consists of pesticides such as DDT, industrial chemicals such as polychlorinated biphenyls (PCBs), and unintentional by-products of industrial processes such as dioxins. The EU supports proposals to add additional chemicals to the convention.

The convention aims to ensure the sound environmental management of chemical stockpiles and waste that contain POPs. EU legislation implementing the Stockholm Convention goes further than the international agreement. Its aim is to eliminate, rather than just restrict, the production and use of internationally recognised POPs. The EU adopted an implementation plan in 2007 to complement Member State national plans.

The European Commission and its Member States also work under the Protocol to the Regional United Nations Economic Commission for Europe's Convention on Long-Range Transboundary Air Pollution on POPs, which entered into force in 2003. The UNECE Protocol targets 16 POPs, although additional chemicals can be added.

Further information:
http://ec.europa.eu/environment/pops/index_en.htm

The Rotterdam Convention is another global treaty addressing the risks of certain hazardous chemicals and pesticides in international trade.

The convention covers pesticides and industrial chemicals that are banned or severely restricted in participating countries. It facilitates the exchange of information on those chemicals and gives countries the right to refuse imports of certain chemicals which they cannot manage safely. This is known as the Prior Informed Consent (PIC) procedure.

EU legislation goes significantly beyond the convention's requirements, covering all countries, whether they are party to the convention or not, and includes a broader range of chemicals. The EU requires the explicit consent of importing countries before PIC chemicals and chemicals qualifying for PIC notification can be exported. It also requires all dangerous chemicals to be appropriately packaged and labelled when exported.

Further information:
http://ec.europa.eu/environment/chemicals/pic/

The **Basel Convention** came into force in 1992 in response to concerns about the risks of international shipments of hazardous and other waste.

Economic growth and globalisation in recent decades has led to an increase in the transport of waste across borders by road, rail or ship. These shipments of waste sometimes involve hazardous wastes and can be harmful to human health and the environment. The convention regulates the movements of hazardous and other wastes across borders by applying the Prior Informed Consent (PIC) procedure. Shipments made without consent are illegal. The convention also obliges its parties to ensure hazardous and other wastes are managed and disposed of in an environmentally-sound manner.

In July 2007 new EU legislation on shipments of waste was adopted. It streamlined the existing control procedures, incorporating recent changes in international law and strengthened conditions on enforcement and cooperation between Member States in cases of illegal shipment. Its aim is to reinforce, simplify and provide more detail on the existing procedures for controlling waste shipments.

Further information:
http://ec.europa.eu/environment/waste/shipments/index.htm

International chemicals management programmes

In 1978, the Paris-based **Organisation for Economic Cooperation and Development (OECD)**, established a programme to help its 30 industrialised member countries develop effective policies and tools for protecting human health and the environment. In recent years a number of developing countries have joined the programme. Together, the participating countries cover almost 90% of global chemicals production.

The programme has developed many tools and instruments for information gathering, testing, and the assessment and management of the safety of chemicals and pesticides. In this way, the main chemicals producing countries in North America, Europe and the Asia-Pacific region can benefit from the collective experience and scientific knowledge available. One of the main achievements has been the establishment of the Mutual Acceptance of Data (MAD) scheme, which is greatly reducing the costs of testing.

The European Commission provides significant financial support to the OECD Chemicals Programme and actively participates in its work.

Further information:
http://www.oecd.org/department/0,3355,en_2649_33713_1_1_1_1_1,00.html
http://www.oecd.org/department/0,3355,en_2649_34365_1_1_1_1_1,00.html

The **United Nations Environment Programme (UNEP) Chemicals Branch** is the centre for all chemicals-related activities of the United Nations Environment Programme and the catalyst for the UN system for global action on the environmentally sound management of chemicals. UNEP Chemicals was responsible for launching the negotiations for the Basel, Stockholm and Rotterdam Conventions and will provide the secretariat for the recently agreed international negotiations on mercury. It works with developing countries to build capacity in the clean production, use and disposal of chemicals and disseminates information on chemical safety.

Both the Commission and the EU Member States have provided significant support to UNEP Chemicals.

Further information:
http://www.chem.unep.ch

SAICM IN PRACTICE

Focus on specific projects to promote sound environmental management of chemicals in the EU and beyond

Basel Convention Coordinating Centre for the African Region in Nigeria

Managing electronic waste in Africa

2008 European Commission project

With most Information and Communication Technology (ICT) – such as computers, TVs and mobile phones – becoming obsolete after only a few years, e-waste is the fastest growing type of waste in the world. In Africa, which has undergone a technology revolution in recent years, this is becoming a serious cause for concern.

Safe collection and management of electronic waste is essential because these products are made up of numerous different materials and chemicals, many of which are toxic. Such systems are not yet in place in many developing countries. This not only leads to pollution and health risks, but also means business opportunities in material recovery and recycling are being missed.

E-waste is generated in all major residential areas and business locations in Africa. In coastal West Africa, this problem is aggravated by a constant stream of used and obsolete electronic equipment entering ports from industrialised countries.

Complementing measures taken within the EU to better control waste flows to Africa, the European Commission is funding a project focusing particularly on North and West African countries to tackle the e-waste problem. It aims to encourage African countries to comply with international agreements and implement national laws and regulations concerning electronic waste.

The project will involve a research study on used and obsolete e-equipment that is imported – in particular from European countries – into West Africa and other African countries. The results of the study will be used to prepare national assessments on e-waste and environmentally-sound management plans in two importing countries. In one of these countries, the functioning and sustainability impacts of the e-waste sector will be investigated.

The project includes a programme in five importing countries – Benin, Egypt, Ghana, Nigeria and Tunisia – to prevent illegal trafficking of e-waste. It will recommend measures for monitoring and controlling cross-border movements. The programme will also include a scheme for exchanging information between exporting and importing countries in Africa and in Europe.

The project will give advice on how countries can benefit from recovering and recycling e-waste in the countries concerned, since the end of illegal trafficking will not eliminate the great deal of waste currently requiring proper treatment and domestic use of electric and electronic equipment is continuing its upward trend in Africa.

Further information:
*http://ec.europa.eu/europeaid/where/worldwide/environment/documents/2008_aap_enrtp_en_*

Training Chinese policy makers and regulators on REACH

June and October 2008, Delegation of the European Commission in Beijing

China is in the process of reforming its regulatory framework for managing the risks posed by chemicals. While current regulations, measures and guidelines cover hazardous chemicals and the testing and registration of new chemicals, there is a need for more comprehensive national policy, legislation, law enforcement and public participation. Many harmful substances that are banned or strictly controlled in the EU are still produced and used without restriction in China. This has led to frequent accidents involving hazardous chemicals.

To explore how China could build on aspects of REACH to develop its laws on chemical risk management, the European Commission ran two sets of training courses in June and October 2008. Some 40 participants from the Chinese Ministry of Environmental Protection and affiliated institutes, as well as representatives from the State Administration of Work Safety, the Ministry of Health and Provincial Environmental Protection Bureaus, took part.

Delegation of the European Commission in Beijing

The programme, supported by the EU-China Policy Dialogues Support Facility, explained EU standards, procedures and legislation and highlighted aspects of REACH that might be integrated into any reform of China's regulatory framework. The sessions raised a number of issues of interest to Chinese policy makers, such as the impact of EU chemical law on current and future China chemical regulations. The training programme also created a pool of experts who will be able to continue the training and dissemination in China.

Some specific elements of REACH have already been integrated into recent regulations in China.

The training materials and background documents used in the courses are available on the following website (in English and Chinese):

Further information:
http://www.eu-chinapdsf.org/english/NewsInfo.asp?NewsId=895

Sound chemicals management for a healthier environment in India and Vietnam

2006 to 2008, European Commission and Germany

A project co-financed by the European Commission and the German Federal Ministry for Economic Cooperation and Development has helped strengthen the capacities of authorities in India and Vietnam to develop environmentally sound and sustainable management of chemicals and pesticides in semi-urban and urban areas.

Some 100 local staff from government institutions, business associations, professional training centres and universities were trained in how to support chemical-intensive small and medium-sized businesses. Training was aimed at improving efficiency in the production process and raising awareness about health and environmental risks.


Alberto Camacho


Alberto Camacho

Managers of 50 small and medium-sized businesses (SMEs) received on-site coaching in how to manage chemicals and hazardous waste in a safe and environmentally sound manner. The companies reported increases in efficiency and cost savings of at least 10 to 15 % of total production costs through improved chemicals management. The project also led to improvements in health and safety for around 3,000 workers.

As a result of national stakeholder consultations, the project produced two policy guidance documents outlining the gaps in policy making and regulatory action in the area of chemicals management.

The Sri Ramachandra University in India and the Centre for Environmental Consultancy and Training in Vietnam, which collaborated with the German Technical Cooperation (GTZ) on the project, will act as resource centres for future support to training activities of national authorities and companies.

Further information:
http://www.chemicalmanagement.org

Study to determine emission factors for hazardous substances released from open burning of waste in developing countries

2007 to 2009, Sweden


UNEP Chemicals Branch


UNEP Chemicals Branch

In a project carried out by the United Nations Environment Programme (UNEP), Sweden, the United States[1], China and Mexico are helping to develop a method for determining emission factors for two families of toxic chemicals known as dioxins and furans produced during waste burning in developing countries.

Under the Stockholm Convention, the 162 countries that are party to the convention are required to develop a dioxin inventory. The first inventories showed that the majority of dioxin emissions in developing countries come from open burning processes in agriculture, forestry or waste.

Developing countries do not typically have incinerators for safe waste disposal, so the waste is dumped and burned. The burning of waste in the open without any technical equipment is often considered as the largest source of dioxins and furans – larger than from all other industrial sources.

As there is currently no measured data to estimate the release of these chemicals in developing countries, Sweden, the United States, China and Mexico have joined forces through this project to fill the knowledge gap.

China and Mexico have provided detailed information on the composition of waste that is burned in the open and on the conditions under which the waste is burned. The expertise in dioxin research and emission factors, and the burning facilities were provided by Sweden and the United States.

Cooperation between developed and developing countries facilitated by the project provides a strong potential for capacity-building between governments, research groups, NGOs, and industry.

The results will be used to propose best environmental practices to reduce the release of dioxins and furans and reduce the exposure of people living close to sites where burning takes place.

Further information:
http://www.chem.unep.ch/Pops/pcdd_activities/projects/opburn0709.htm
http://www.chem.unep.ch/Pops/pcdd_activities/toolkit%20experts%20meetings/default.htm

[1] Additional funding by Chlorine Chemistry Division, USA.

Substitution of DDT-based anti-fouling paint project in China

2007 to 2009, Sweden

Before its use was banned by the Stockholm Convention, DDT was an important constituent of anti-fouling paints, used to kill the spores and larvae of marine fouling organisms that attach themselves to the hulls of boats and ships.

Supporting China in its efforts to come to full compliance with the Stockholm Convention, this Swedish project aims to guide the Chinese authorities in the choice of alternatives to the wide use of DDT-based anti-fouling paints on smaller boats in China. The programme will work with Chinese Ministry of Environmental Protection (MEP/FECO) and the regional and local environmental bureaus. The project was due to start in 2007 but was delayed due to the powerful earthquake that hit China. It re-started in 2009.

KEMI, the Swedish chemicals agency, will share its experience with legislation and assessment methods, focusing on anti-fouling paints. This will include the Swedish risk mitigation method of substituting hazardous substances with less hazardous ones. Planned activities include study visits to research stations and site visits to shipyards to examine environmentally-friendly alternatives (including mechanical anti-fouling procedures) both in Sweden and the United Kingdom. Training workshops for environmental authorities in Sweden and in China will facilitate continuing contact between the authorities.

Further information:
http://www.kemi.se

Clean-up projects in environmental hotspots in Serbia

2005 to 2007, Czech Republic

The bombing of two oil refineries and a chemical plant in Pancevo (NIS Oil Refinery and HIP Petrochemija) and Novi Sad (NIS Oil Refinery) during the Kosovo conflict in 1999 led to major spillages of oil and chemicals which contaminated ground water and caused major environmental and human health risks.

Based on the results of the UNEP "hotspots" evaluation, the Czech and Serbian Ministries of the Environment cooperated in the clean-up project which was carried out by a team of Czech and local experts. The project involved assessing the level of contamination (measurement, sampling, analysing of sediments), performing pilot clean-up tests and the preparation of the final clean-up plan. Contamination surveys and a laboratory-scale pilot test of bioremediation – a method which allows natural processes to clean up harmful chemicals in the environment – were performed on the contaminated soil. Feasibility studies were prepared based on the pilot tests. The operation of the groundwater remediation system in Pancevo was monitored, evaluated, optimised and updated. The training of Serbian experts in a Czech refinery plant and cooperation with local authorities were integral parts of the project.

The project led to reduced groundwater contamination, especially in HIP Petrochemija, Pancevo. Some 300 kg of contaminants were cleaned up daily, significantly decreasing risks to human health and the environment. Capacity-building activities, transfer of technologies and know-how contributed to a fully-operational groundwater remediation system in HIP Petrochemija. The remediation activities continue.

Further information:
http://www.mzp.cz/en/international_development_assistance


Czech Ministry of the Environment

Defra/FCO

Integrated programme for the SAICM in Mexico

2007 to 2009, UK

Mexico has developed procedures to achieve an integrated approach to chemicals management in Latin America.

The project, which took place in the framework of the United Kingdom-Mexico Sustainable Development Dialogue, aimed to increase Mexico's capacity to handle chemicals safely, identify areas for improvement, and contribute to raising awareness across different sectors of the need to better integrate safe management of chemicals into national policy.

This process required a coordinated effort among different government actors, industry, academia and other sectors of society. Partnerships and institutional capacity-building were crucial to establishing initiatives, policies and strategies for risk prevention instruments and reduction of the adverse effects of chemicals. Stakeholders involved included the National Chamber of Chemical Industries (ANIQ), the Ministries of Health, Customs, Foreign Affairs, Economy, Labour, Agriculture and Environment, as well as universities and research centres.

The project consisted of three major activities, starting with a priority-setting workshop. Some 95 people from 12 government departments, businesses, industrial organisations, and various universities, attended. A national chemicals profile – a record of chemical substances and available information on in-country production, import, export, use and waste-generation of chemical substances – and a national capacity report were also developed The national capacity report was based on the United Nations Institute for Training and Research (UNITAR) guidelines.

Lessons learned were shared with other countries from the Latin America and Caribbean Region at a SAICM Regional Workshop in December 2008, during the 1st International Seminar on Rational Strategies for Chemical and Waste Management held in Chile. A number of other countries in the region expressed an interest in developing their own plans to implement SAICM.

Further information:
http://ukinmexico.fco.gov.uk/en/working-with-mexico/Sustainable_Development/SDD_Programme/Themes_Projects/
http://www.ine.gob.mx

Toxic-free toys campaign

2008, Women in Europe for a Common Future (WECF)

Women in Europe for a Common Future (WECF), a non-governmental organisation (NGO) working for sustainable development, protection of human health and environment and poverty reduction, organised a public toy test in three European cities in the run-up to Christmas 2008. The aim was to raise awareness of the potential dangers posed by chemicals in some children's toys.

WECF invited two laboratories to test a selection of toys brought along by parents. The tests showed the presence of formaldehyde in plywood puzzles and the treatment of stuffed toys with brominated flame retardants. Medical experts advised on preventive actions parents could take. The main TV-channels and newspapers of Germany, The Netherlands, and France covered the campaign.

To coincide with the 60th International Nuremberg Toy Fair in January 2009, WECF published a Toys Guide which provides tips on choosing toxic-free toys. The brochure provides concise information about the most hazardous substances found in toys. It also gives concrete tips on how consumers can play it safe when buying toys for children.

Further information:
http://www.wecf.eu/

PRISME^2 Promoting Responsibility in SMEs

2008-2010, European Chemical Industry Council (CEFIC)

Greater involvement of small and medium-sized enterprises (SMEs) in promoting responsibility for sound chemicals management is one of the key objectives of the new Cefic-led project, known as PRISME^2.

The project seeks to promote the industry's Responsible Care® initiative under which companies work – through their national associations – to continuously improve their environmental health and safety performance. Since it was launched in 1985, Responsible Care® has helped European companies substantially improve their HSE performance and their profitability.

PRISME^2 shares the same goals as Responsible Care®. These include identifying energy saving measures, reducing the number of working days lost to sickness and injury and building relationships with local communities. The objectives also involve reducing emissions, promoting the responsible use of resources and sustainable management of waste and ensuring the safe management of chemicals throughout the value chain.

To meet the needs of SMEs, the PRISME^2 project pursues two strategies. It gathers best practices and tailor-made tools applicable in the business environment of small companies. It also establishes a networking programme based on workshops involving experts from industry, authorities and trade unions.

The project's squared symbol reflects redoubled efforts from industry, trade unions, managers and employees. Trade unions are key partners in PRISME^2. In Europe, they have been significantly involved in Responsible Care® since 2004.

Cefic's EU partners in this multi-stakeholder project are the European Mine, Chemical and Energy Workers' Federation (EMCEF), the European Chemical Employers Group (ECEG)

and Tomorrow's Company, a United Kingdom-based think tank that examines the role of business and its relationship with society and the environment. Other partners include chemical industry associations and sector trade unions in six countries piloting the project between mid 2009 and 2010: The Czech & Slovak Republics, Germany, Greece, Spain and the United Kingdom. Following the pilot, PRISME^2 will be rolled out across the European chemical industry.

The EU co-funds the project under the EU's Directorate-General for Enterprise and Industry programme on Corporate Social Responsibility. DG Enterprise and Industry has promoted the corporate social responsibility (CSR) agenda in the EU for many years, with particular emphasis recently on reaching small and medium-sized enterprises.

Further information:
http://www.cefic.org/en/prisme2.html

EUROPEAN COMMISSION FINANCIAL ASSISTANCE

European Commission financial assistance

to developing countries and international activities for environmentally sound chemicals management

The European Union is a strong supporter of SAICM and its policies and legislation are fully in line with SAICM principles and objectives. Chemicals management is very much an international and global matter. This is why the European Commission channels some of its development aid towards chemicals management.

In keeping with the country-driven approach, the vast majority of European Commission assistance goes to priorities set by developing country governments themselves. Governments wishing to receive support from the Commission to meet SAICM objectives must come forward with project proposals.

The European Commission recognises that there are reasons why environmental protection in general, and sound chemicals management in particular, is not a priority for many developing countries in their use of aid. As a result, the Commission has a specific programme of environmental support, the thematic programme for environment and the sustainable management of natural resources, including energy (ENRTP). This includes an allocation of some €15 million for the period 2007 to 2010 to tackle chemicals, wastes and sustainable consumption and production. This funding is in addition to money allocated to bilateral programmes and is used to fund the work of international organisations.

The first ENRTP allocation for chemicals was approved for SAICM in 2007, €2.4 million of which went to the Quick Start Programme, while €0.6 million financed a multi-faceted project supporting the work of the Secretariat. This involved an awareness-raising project by a coalition of NGOs and funding for the participation of developing countries at the 2nd International Conference on Chemicals Management (ICCM) – SAICM's governing body. The ENRTP has also been used to support SAICM-related Multilateral Environmental Agreements.

Before the adoption of SAICM, the forerunner of the ENRTP also supported projects relevant to SAICM objectives, including capacity-building, the dissemination of information and work on pesticides. Between 2003 and 2006, some €4.5 million was allocated to these activities.

Examples of recent projects supported by the European Commission.

In 2007-2008, African, Caribbean and Pacific countries (ACP) requested €1.95 million from a regional allocation through the Quick Start Programme (QSP) for initial SAICM implementation and capacity-building. Some €4.5 million were also provided for cleaning up obsolete pesticides in Africa in cooperation with the Food and Agriculture Organisation (FAO) (Africa Stockpiles Programme). The funds were committed by the Commission in 2008.

The key chemicals management projects financed or committed by the European Commission in recent years include:

Year	Country-Region	Contractor	Project	EC contribution in €
2003	Global	Pesticide Action Network UK (PAN-UK)	Pesticides and poverty: implementing chemical conventions	**1,173,957**
2003	Africa	World Bank	Africa Stockpiles Programme horizontal activities	**1,000,000**
2003	All/multiple developing countries and countries in transition	WHO – Intergovernmental Forum on Chemical Safety (IFCS)	Capacity building for the use of and contribution to INFOCAP (Information exchange Network on capacity-building for the sound management of chemicals)	**500,000**
2003	All/multiple developing countries	United Nations Institute for Training and Research (UNITAR)	Assisting developing countries to prepare national profiles, set priorities and strengthen information exchange for the sound chemicals management	**760,000**
2004	Asia	UITAR	Strengthening national and regional capacities for implementing the Globally Harmonised System of Classification and Labelling of Chemicals (GHS) in ASEAN	**926,566**
2006	Global	UNEP	SAICM Secretariat activities	**150,000**
2006	Global	OECD	Promotion of the use of Quantitative Structure Activity Relationships (QSAR) in regulatory assessments	**250,000**
2007 & 2008	Global	Rotterdam Convention	Capacity-building for developing countries and support for participation in conference of parties (COP)	**180,000**
2007	Global	Stockholm Convention	Development of a toolkit on reducing dioxin emissions	**100,000**
2007	Global	Montreal Protocol	Support of the technical panels' work on making the Protocol more effective in combating ozone depleting substances	**300,000**

2007 & 2008	Global	UNEP	Preparatory work for and participation of developing countries in decision-making on mercury	**280,000**
2007	Global	UNEP	SAICM secretariat, Outreach and Participation in ICCM 2	**600,000**
2007	Global	UNEP	SAICM Quick Start Programme Trust Fund	**2,400,000**
2008	African, Caribbean and Pacific countries	UNEP	SAICM Quick Start Programme Trust Fund	**1,950,000**
2008	Africa	FAO	Clean-up of obsolete pesticides, improving pesticides management and sustainable pest management	**4,448,220**
2008	Africa		Building local capacity to address the flow of e-wastes and electric or electronic products destined for reuse	**1,000,000**
2008	Coal dependent emerging economies	UNEP	Reducing Mercury Emissions from Coal Combustion	**999,915**
2008	Global	UNIDO and Blacksmith Institute	Global Identification and Evaluation of Polluted Sites	**580,000**
2008	Global	Montreal Protocol	Information-sharing on HCFCs and mobile air conditioning	**400,000**
2008	Global	OECD	Review and development of test guidelines for the safety testing and assessment of manufactured nanomaterials	**50,000**
2008	Global	OECD	Promotion of the use of Quantitative Structure Activity Relationship (QSAR) models and their integration into different regulatory frameworks	**500,000**
2003 - 2008	**Total identified** [2]			**18,550,000**

[2] This does not include actions that were taken under bilateral and regional rural development projects

European Commission financial assistance

European Commission

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Contents

1. The Chemical Substances Control Law: the current version

The Current Version of the Chemical Substance Control Law: Overview

[Purpose]

The purpose of this Act is to evaluate, before manufacture or import, whether or not new chemical substances have properties such as persistence, and to implement necessary regulations, in order to prevent environmental pollution caused by chemical substances that are persistent and pose a risk of impairing human health or interfering with the inhabitation and/or growth of flora and fauna.

[Evaluation Criteria]

(1) Persistence (environmental persistence), (2) Bioaccumulation potential, (3) Toxicity for humans or flora and fauna

[Key Points]

- Notification and evaluation of new chemical substances (i.e., chemical substances that were newly manufactured or imported in or after 1973 and have not been evaluated) prior to the manufacture or import.
- Manufacture and/or import of these substances will be permitted without notification and/or evaluation upon confirmation by the government in such cases as the substance is manufactured or imported within a limited volume (the national total tonnage $\leq$ 1 ton), and the substance is an intermediate or a closed system.
- Manufacture and/or import of these substances up to 10 tons (i.e., “low production”) will be permitted without toxicity evaluation if persistence and low bioaccumulation potential are confirmed as a result of the evaluation.
- The existing chemical substances (i.e., the chemical substances manufactured or imported in or before 1973) are to be studied and evaluated by the government.
- The chemical substance will be subject to regulation (e.g., obligation of notification on the amount to be manufactured/imported, limitation on manufacturing, import and/or use) according to its properties found in the evaluation.

Chemical Substances Subject to the Chemical Substance Control Law

○ “Chemical substances” refers to compounds that are obtained by a chemical reaction on an element or a compound.

○ The chemical substances subject to the Chemical Substance Control Law are those used for general industrial chemical products. Those substances that are subject to other regulations that are equally or more stringent regulations (Poisonous and Deleterious Substances Control Act) or more specific to the usage of the substance (Food Sanitation Act) are exempted from this law.

		Regulations on manufacturing, etc.	Regulations on emissions	Regulations on waste
Chemical substances		- Elements and natural products	[Water Pollution Control Act] [Air Pollution Control Law] [Soil Contamination Countermeasures Act]	[Waste Management and Public Cleansing Law]
	Chemical substances subject to the Chemical Substance Control Law	**General usage (industrial)** - General industrial chemical products **Specific usage** [Food Sanitation Law] Foods, additives, containers and packaging, toys and detergents [Agricultural Chemicals Regulation Act] Agricultural chemicals [Fertilizers Regulation Act] Ordinary fertilizers [Act on Safety Assurance and Quality Improvement of Feeds] Feeds and feed additives [Pharmaceutical Affairs Act] Drugs, quasi-drugs, cosmetics, and medical equipments		
		[Law concerning Prevention of Radiation Hazards due to Radioisotopes, etc.] Radioactive substances [Poisonous and Deleterious Substances Control Act] Specified poison [Stimulant Drug Control Act] Stimulant and raw materials for stimulants [Narcotics and Psychotropics Control Act] Narcotic		

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The Current Version of the Chemical Substance Control Law: the Whole Picture

Existing chemical substances (Approx. 20,600 substances)
(Chemical substances that were already manufactured/imported at the time of the promulgation of the Chemical Substance Control Law)

New chemical substances

- Total manufacturing and import/year > 1 ton/year
- Total manufacturing and import/year ≤ 1 ton/year
- Substances specified by Cabinet order (e.g., intermediates)

Notification and evaluation (Data are submitted by private corporations)

Confirmation (approval for manufacturing and/or import)

Persistent. Highly bioaccumulative. Long-term toxicity for humans or predator animals at higher trophic level

Not readily biodegradable /not highly bio accumulative ≤ 10 ton/year

Hazard assessment and evaluation (by the government)

Not readily biodegradable /not highly bioaccumulative

Persistent /highly bioaccumulative

Suspected long-term toxicity for humans

Suspected toxicity for flora and fauna

Type I Monitoring Chemical Substances (36 substances)
[Persistent. Highly bioaccumulative. Toxicity unknown]
- Mandatory reporting of actual amounts manufactured and/or imported/ usage, etc.

Class II Monitoring Chemical Substances (952 substances)
[Persistent. Not highly bioaccumulative. Suspected long-term toxicity for humans]
- Mandatory reporting of actual amounts manufactured and/or imported, usage, etc.

Class III Monitoring Chemical Substances (157 substances)
[Persistent. Not highly bioaccumulative. Suspected long-term toxicity for flora and fauna]
- Mandatory reporting of actual amounts manufactured and/or imported, usage, etc.

Investigation of toxicity directed

Investigation of toxicity directed

Investigation of toxicity directed

Has long-term toxicity to humans or predator animals at higher trophic level

Has long-term toxicity for humans

Has long-term toxicity for flora and fauna in the human living environment

Class I Specified Chemical Substances (16 substances)
[Persistent. Highly bioaccumulative. Has long-term toxicity for humans or long-term toxicity for predator animals at higher trophic level]
- Prior permission is required for manufacture and/or import (virtually prohibited)
- Import of certain products specified by Cabinet order is prohibited
- Any uses other than specified by Cabinet order are prohibited
- Criteria in handling of the substance must be met
- Implementation of recallsand other measures may be ordered

Class II Specified Chemical Substances (23 substances)
[Persistent. Not highly bioaccumulative. Has toxicity for humans or long-term toxicity for flora and fauna in the human living environment]
- Mandatory reporting of planned and actual amounts manufactured and imported
- If deemed necessary, the government issues orders to change the planned manufacture and import amounts
- The government provides technical guidelines, recommendations
- Mandatory labeling for the products specified by cabinet order

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Restrictions according to the Properties, etc. of Chemical Substances

○ The Chemical Substance Control Law regulates the restrictions and measures according to the properties the substance (e.g., persistence, bioaccumulation, long-term toxicity for humans, and long-term toxicity for flora and fauna) and the residual conditions in the environment.

Regulatory Classification	Restrictions
Class I Specified Chemical Substances (16 substances including PCBs) Chemical substances that are persistent, are highly bioaccumulative, and have long-term toxicity for humans or long-term toxicity for flora and fauna.	- Prior permission is required for manufacture and/or import (virtually prohibited) - Any use other than specified by Cabinet order uses are prohibited - Import of certain products specified by Cabinet order is prohibited - Implementation of recall and other measures may be ordered (in case when the substance and/or product is specified and when the statutes are not complied with)
Class II Specified Chemical Substances (23 substances including trichloroethylene) Chemical substances that are persistent and have toxicity for humans or long-term toxicity for flora and fauna in the human living environment	- Mandatory reporting of planned and actual amounts manufactured and/or imported, usage, etc. - If deemed necessary, the government issues orders to change the planned manufacture and import amounts - The government provides technical guidelines, recommendations for handling - Mandatory and recommended labeling
Type I Monitoring Chemical Substances (36 substances including cyclododecan) Existing chemical substances that are confirmed to be persistent and highly bioaccumulative	- Mandatory reporting of actual amounts manufactured and/or imported, usage, etc. - Name of the substance and reported amounts of manufacturing and/or import is publicized by the government for the substances whose total volume is at least 1 ton. - Guidelines, advice, etc. (when necessary to prevent environmental pollution) - When necessary, government directs manufacturers and importers to investigate the long-term toxicity for humans or for predator animals at higher trophic level
Type II Monitoring Chemical Substances (952 substances including chloroform) Chemical substances that are not highly accumulative but are not readily biodegradable and suspected to have long-term toxicity	- Mandatory reporting of actual amounts manufactured and/or imported, usage, etc. - Name of the substance and reported amounts of manufacturing and/or import is publicized by the government for the substances whose total volume is at least 100 tons. - When necessary, the government directs manufacturers and importers to investigate the long-term toxicity for humans
Type III Monitoring Chemical Substances (157 substances including cadmium nitrate) Chemical substances that are persistent and have toxicity for general flora and fauna (ecotoxicity)	- Mandatory reporting of actual amounts manufactured and/or imported, usage, etc. - Name of the substance and reported amounts of manufacturing and/or import is publicized by the government for the substances whose total volume is at least 100 tons. - When necessary, the government directs manufacturers and importers to investigate the long-term toxicity for flora and fauna in the human living environment

2. Chemical Substance Control Law: Amendment

Amendment of the Chemical Substance Control Law: Overview

The current regulations and measures are reviewed and new measures necessary to rationalize regulations are implemented to reflect international trends. The amendment is also aimed at preventing the adverse influence of harmful chemical substances on humans, flora and fauna through implementation of comprehensive chemical substance management.

Background and Needs of Amendment

1. Increased concerns for chemical substances
   (to ensure safety of the pubic both physically and mentally)
2. Needs to achieve international goals in chemical substance management
   - ○ To minimize the significant adverse effect of chemical substances on human health and environment by 2020 (Agreement in the Environmental Summit in 2002).
     - New regulations (REACH) are already implemented in 2007 in Europe.
   - ○ The Chemical Substance Control Law (enactment in 1973) requires all "new chemical substances" (those manufactured or imported for the first time at the time of enactment or later) to go through prior evaluation.
   - ○ Existing chemical substances at the time of enactment have been subject to hazard assessment by the government, but assessment has not been completed for many of these chemical substances.
3. Unconformity with international conventions
   - ○ In an international convention (the Stockholm Convention), an agreement was made on exceptional use of certain substances that are subject to banning.
   - ○ With the current law, provisions on exceptional use are restrictive, imposing concern that certain uses that are essential to the industries of Japan cannot be ensured.

Amendment: Overview

(1) Measures for the existing chemical substances

- ○ Manufacturers and/or importers of all chemical substances, including existing chemical substances, will have an obligation to report the amount, etc. when manufacturing or importing more than a certain amount of the substance.
- ○ Upon reception of the above report, the government will narrow down and prioritize the chemical substances for detailed safety assessment. The manufacturers and/or importers will be requested to submit information on the level/ type of hazard. Influences of such chemicals on human health, etc. will be evaluated and classified.
- ○ Based on the results, manufacturing and use of the hazardous chemical substances and products containing these substances will be restricted.

(2) Ensuring conformity with international rules

- ○ Use under strict management will be ensured when a chemical substance is newly added to the list of restriction substances in international conventions.
  - Use for semiconductors, etc.

(Reference) Related occurrences

1973 Chemical Substance Control Law enacted
2002 Agreement achieved at the Environmental Summit → 2020 Each state will complete safety assessment
2004 Stockholm Convention came into effect
2007 REACH came into effect (Europe) → 2018 Deadline of final registration for REACH

Shift To Risk-based Management

○ In recent years, chemical substance management policies in the world have shown a shift from **"hazard-based management"** that only takes the intrinsic hazardous properties of chemical substances into account to **"risk-based management"** that also take emissions (exposure) to the environment into consideration.

Risk = **Hazard** × **Environmental release (exposure)**

Hazard: **Potential of chemical substances to impose undesired influence on humans and flora and fauna in the environment**

Exposures: **Amount (concentration) of chemical substances that are exposed to humans and flora and fauna**

The regulation regime will be shifted from the current system that is solely based on the hazard of chemical substances to a "risk-based" system where "environmental release (exposure)" (i.e., likelihood of the chemical substance to impose influence on humans and/or flora and fauna) is additionally taken into account.

(Reference) WSSD: Goal for 2020

○ The World Summit on Sustainable Development (WSSD) in 2002 agreed to achieve, by 2020, a situation where chemicals are used and produced in ways that lead to the minimization of significant adverse effects on human health and the environment.

○ The most important key to meet the WSSD goal is a shift from “hazard-based management” that is solely based on the intrinsic hazard of chemical substances to “risk-based management” that also takes the release (exposure) of chemical substances to humans and the environment into account.

Items relevant to chemical substances

・Renew the commitment, as advanced in Agenda 21, to sound management of chemicals throughout their life cycle and of hazardous wastes

・aiming to achieve by 2020 that chemicals are used and produced in ways that lead to the minimization of significant adverse effects on human health and the environment, using transparent science-based risk assessment procedures and science-based risk management procedures, taking into account the precautionary approach, as set out in principle 15 of the Rio Declaration on Environment and Development.

In 2002, the Johannesburg Plan of Implementation was adopted as a guideline to implement the items in the Agenda 21 agreed at the World Summit on Sustainable Development.

(Reference) International Trend (Measures taken in Europe)

○ In Europe, a new regulation for chemical substances, Registration, Evaluation, Authorization and Restriction of Chemical (REACH) became effective in June 2007. REACH is unique in that (1) Manufacturers and importers of all chemical substances (both new and existing substances) are obliged to register, (2) Chemical substances incorporated into an article, such as electronic and electric devices, are subject to mandatory registration, (3) The major body of risk assessment is shifted to business, and (4) Authorization is required for use, etc. of certain substances, such as carcinogenetic substances. The EU is planning to achieve the 2020 goal through the thorough implementation of risk-based management using REACH regulation.

○ Obligated parties: Manufacturers or importers (including downstream users) within the EU territory, as well as agents designated by companies outside of the EU territory.

○ Obligation: (1) Chemical substances (including ingredients of a preparation) must be registered at the European Chemical Agency (ECHA) with the results of safety assessment and other information. The registrars join the Substance Information Exchange Forum (SIEF) to share the assessment costs.

(2) Manufacturers and importers of articles have to notify the ECHA if their article contains a “substance of very high concern” by 0.1% (w/w) and provide information on the substance to the businesses. Chemical substances with an intended release (e.g., ink in ballpoint pens) in an article have to be registered.

(3) Use and market launch of carcinogenic, mutagenic, and reprotoxic (CMR) substances, etc. are prohibited except for the specific cases where authorization is given.

○ Timeline: June 1st, 2007: Enactment (ECHA starts operation)
June 1st to December 1st, 2008: Preregistration (Extended registration deadlines below are applied after preregistration)
November 30th, 2011: Registration deadline for chemical substances manufactured and/or imported in volumes ≥ 1,000 tons/year.
June 1st, 2011: Notification of SVHC in articles begins
May 31st, 2013: Registration deadline for all substances manufactured or imported in volumes ≥ 100
May 31st, 2018: Registration deadline for all substances manufactured or imported in volumes ≥ 10

(Reference) Detailed Timeline for REACH

Timeline for substances (registration, etc.)	Timeline for articles (notification, etc.)
○ June 1st, 2008: REACH regulations start operation	
○ June 1st, 2008 to December 1st, 2008: Preregistration (registration can be extended by preregistration)	○ October 28th, 2008: Obligation to report information starts for 15 SVHC substances according to the Article 33
○ By December 1st, 2008: EU member states establish penalties for infringements of REACH and report to EC	
○ Starting February 2009: Substance Information Exchange Forum (SIEF) is in operation (to discuss how to share substance safety data, etc. necessary for registration) ○ Candidate list discussed and determined ○ November 30th, 2010: Registration deadline for substances manufactured or imported in volume ≥ 1,000 tons/year, CMR (carcinogenic, mutagenic, and reprotoxic) substances in volume ≥ 1 tons/year, and substances classified as “very toxic to aquatic organisms and may cause long-term adverse effects in the aquatic environment” in volume ≥ 100 tons/year. ○ May 31st, 2013: Registration deadline for substances manufactured or imported in volume ≥ 100 tons/year but < 1,000 tons/year ○ May 31st, 2018: Registration deadline for substances manufactured or imported in volume ≥ 1 tons/year but < 100 tons/year	○ March 2009: Discussion and addition of SVHC substances to the list starts (public consultation starts) ○ May 31st, 2011: Notification deadline for SVHC substances (those listed 6 months earlier or before) ○ Starting June 1st, 2011: SVHC substances must be notified within 6 months after publishing on the list

(Reference) REACH Preregistration Status

◆ **Preregistration Status (as of December 7th, 2008):**

- **Number of companies signed up through REACH-IT: ≈ 65,000 (82% consists of small and medium-sized enterprises)**
- **Number of registrations: ≈ 2,600,000**

  Germany: ≈ 820,000; UK: ≈ 440,000; France: ≈ 340,000; Poland: ≈ 190,000; Netherland: ≈ 130,000; Italy: ≈ 120,000
- **Number of substances registered: ≈ 150,000**

  Substances without EINECS number: ≈ 26,500 (substances with CA number: ≈ 17,000)

  Multicomponent substance: ≈ 14,500

  While most SIEFs are expected to consist of 1 to 9 companies, 2 SIEFs have already been signed up by more than 5,000 companies.
- **Challenges: - Many cases of registration were made directly from outside the EU territory, which have been deleted.**
  - **Some articles and "cow"s were preregistered.**
  - **3 organizations which are believed to be "Only Representative" entities made about 1,500 cases of preregistration without declaring its representation of companies located outside the EU territory.**

(Reference) International Trend (Response by the U.S.)

○ The U.S. has been evaluating the risk of all chemical substances launched on the market through the Toxic Substances Control Act (TSCA) and the US Challenge Program, a program to collect safety information of high production volume (HPV) chemical substances with the cooperation of the private sector. More recently, a collaborative framework was established with Canada and Mexico. With these measures, the U.S. is planning to achieve the 2020 goal.

Measures taken by the U.S.

◇ In 1998, the US Challenge Program (a program to collect and make publicly available data on safety of HPV with cooperation of companies) was started.

◇ In 2005, the chemical industry in the U.S. voluntarily started extending its work on HPV.

◇ In 2007, the leaders of the U.S., Canada and Mexico agreed to develop a regional cooperation in chemical substance regulation. The U.S. Environmental Protection Agency (EPA) started publishing the evaluation results of safety information collected through the US Challenge program.

◇ By 2012, EPA will complete the risk evaluation of HPVs and finish the validation procedures of safety information on chemical substances in volume of at least 10 tons/year.

(Source: U.S. Environmental Protection Agency)

Key Points of Amendment of the Chemical Substance Control Law

(1) Introduction of a comprehensive control system that covers the existing chemical substances

(a) Companies that manufacture or import any chemical substance, including existing substances, in excess of the specified amounts will be newly obliged to notify the quantity and use information for each fiscal year.

(b) Chemical substances which the government identifies, from the content of their notifications and available knowledge of their hazardous properties, as having higher priority in risk assessment will be designated as Priority Assessment Chemical Substances" (PACs)".

(c) Manufacturers and importers of those PACs may be required to submit information on hazardous properties and companies handling them may be required to report their uses as necessary.

(d) Among the PACs that are deemed, as a result of the information gathering and the risk assessment, to raise concerns about adverse effects on humans or flora and fauna will be subject to regulations on manufacture and use as "Class Ⅱ Specified Chemical Substances," as in the existing Law.

(e) In addition to "chemical substances that are persistent in the environment," which have been subject to control under the current Law, "chemical substances that are not persistent in the environment" will be regulated in the amended Law.

(2) Appropriate control of chemical substances in the supply chain

To prevent environmental pollution by the Specified Chemical Substances and products containing them, the amended Law will require companies handling them to adhere to specific handling standards and oblige these companies to label the products with necessary information for transactions.

(3) Rationalization of evaluation and regulation systems in light of international trends

The government will eliminate international inconsistencies in its regulations, for example, by reviewing regulations on the Class I Specified Chemical Substances in order to permit the exceptional use of the substances listed under the Stockholm Convention under strict control.

The Chemical Substance Control Law after the Amendment: the Whole Picture (First Phase)

Existing chemical substances
(Approx. 20,600 substances)
(Chemical substances that were already manufactured/imported at the time of the promulgation of the Chemical Substance Control Law)

New chemical substances

Total manufacturing and import/year > 1 ton/year

Total manufacturing and import/year ≤ 1 ton/year

Substances specified by Cabinet order (e.g., intermediates)

Polymers of Low Concern

Persistent. Highly bioaccumulative. Long-term toxicity for humans or predator animals at higher trophic level

Notification and evaluation (Data are submitted by private corporations)

Not readily biodegradable /not highly bioaccumulative

Not readily biodegradable /not highly bioaccumulative ≤ 10 ton/year

Confirmation (approval for manufacturing and/or import)

Hazard assessment and evaluation (by the government)

Persistent/ highly bioaccumulative

Including substances not highly persistent

Suspected long-term toxicity for humans

Including substances not highly persistent

Suspected long-term toxicity for flora and fauna

Type I Monitoring Chemical Substances
[Persistent. Highly bioaccumulative. Toxicity unknown]
- Mandatory reporting of actual amounts manufactured and/or imported, usage, etc.

Class II Monitoring Chemical Substances
[~~Persistent.~~ Not highly bioaccumulative. Suspected long-term toxicity for humans]
- Mandatory reporting of actual amounts manufactured and/or imported, usage, etc.

Class III Monitoring Chemical Substances
[~~Persistent.~~ Not highly bioaccumulative. Suspected long-term toxicity for flora and fauna]
- Mandatory reporting of actual amounts manufactured and/or imported, usage, etc.

Investigation of toxicity directed

Has long-term toxicity to humans or predator animals at higher trophic level

Investigation of toxicity directed

Has long-term toxicity for humans

Investigation of toxicity directed

Has long-term toxicity for flora and fauna in the human living environment

Including substances not highly persistent

Class I Specified Chemical Substance
[Persistent. Highly bioaccumulative. Has long-term toxicity for humans or long-term toxicity predator animals at higher trophic level]
- Prior permission is required for manufacture and/or import (virtually prohibited)
- Import of certain products specified by cabinet order is prohibited
- Any uses other than specified by Cabinet order **(for international consistency of requirements)** are prohibited
- Standards in handling of the substance and **products specified by cabinet order (products containing the substances)** must be met. **Mandatory labeling**
- Implementation of recall and other measures may be ordered

Class II Specified Chemical Substance
[~~Persistent.~~ Not highly bioaccumulative. Has toxicity for humans or long-term toxicity for flora and fauna in the human living environment]
- Mandatory reporting of planned and actual amounts manufactured and imported
- If deemed necessary, government issues orders to change the planned manufacture and import amounts
- The government provides technical guidelines, recommendations on substances and **products specified by cabinet order (products containing the substances)**
- Mandatory labeling for the products specified by cabinet order

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The Chemical Substance Control Law after the Amendment: the Whole Picture (Second Phase)

Existing chemical substances
(Approx. 20,600 substances)
(Chemical substances that were already manufactured/imported at the time of the promulgation of the Chemical Substance Control Law)

General chemical substances
(7,000 to 8,000 estimated)
Mandatory reporting of amounts manufactured and/or imported, usage, etc.

Decision based on exposure, hazard, etc.

Persistent.
Highly bioaccumulative

Monitoring Chemical Substances
[Persistent. Highly bioaccumulative. Toxicity unknown]
- Mandatory reporting of actual amounts manufactured and/or imported, usage, etc.
- Companies handling these substances are obliged to make utmost efforts to disclose information

Report of handling status is required
Investigation of toxicity directed

Has long-term toxicity to humans or predator animals at higher trophic level

Class I Specified Chemical Substances
[Persistent. Highly bioaccumulative. Has long-term toxicity for humans or long-term toxicity for predator animals at higher trophic level]
- Prior permission is required for manufacture and/or import (virtually prohibited)
- Import of certain products specified by Cabinet order is prohibited
- Any uses other than specified by Cabinet order (for international consistency of requirements) are prohibited
- Standards in handling of the substance and products specified by Cabinet order (products containing the substances) must be met. Mandatory labeling
- Implementation of recall and other measures may be ordered

Risk to humans or flora and fauna in the human living environment is sufficiently low

New chemical substances

Total manufacturing and import/year > 1 ton/year	Total manufacturing and import/year ≤ 1 ton/year	Substances specified by cabinet order (e.g., intermediates)	Polymers of Low Concern

Notification and evaluation
(Data are submitted by private corporations)

Not readily biodegradable/not highly bioaccumulative ≤ 10 ton/year

Confirmation (approval for manufacturing and/or import)

Decision based on exposure, hazard, etc.

Risk to humans or flora and fauna in the human living environment is not sufficiently low

Priority Assessment Chemical Substances (PACs)
(Approx. 1,000 substances are expected to be specified)
[~~Persistent.~~ Not highly bioaccumulative. Suspected long-term toxicity for humans]
- Mandatory reporting of actual amounts manufactured and/or imported, detailed usage, etc.
- Companies handling these substances are obliged to make utmost efforts to disclose information

Note: Type II and Type III Monitoring Chemical Substance discontinued. Priority Assessment Chemical Substances may be specified from the substances previously categorized in these types

Including substances not highly persistent

Report of toxicity and handling status is required
Investigation of toxicity directed

Has risk for humans or flora and fauna in the human living environment

Including substances not highly persistent

Class II Specified Chemical Substances
[~~Persistent.~~ Not highly bioaccumulative. Has toxicity for humans or long-term toxicity for flora and fauna in the human living environment]
- Mandatory reporting of planned and actual amounts manufactured and imported
- If deemed necessary, government issues orders to change the planned manufacture and import amounts
- The government provides technical guidelines, recommendations on substances and products specified by Cabinet order (products containing the substances)
- Mandatory labeling for the products specified by Cabinet order

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Restrictions according to the Properties, etc. of Chemical Substances (after Amendment)

Regulatory Classification	Restrictions
Class I Specified Chemical Substances (16 substances including PCB) Chemical substances that are persistent, are highly bioaccumulative and have long-term toxicity for humans or long-term toxicity for flora and fauna. → **Remain effective**	- Prior permission is required for manufacture and/or import (virtually prohibited) - Any use other than specified by Cabinet order uses are prohibited - Import of certain products specified by Cabinet order is prohibited - Implementation of recall and other measures may be ordered (in case when the substance and/or product is specified and when the statutes are not complied with)
Class II Specified Chemical Substances (23 substances including trichloroethylene) Chemical substances that are persistent and have toxicity for humans or long-term toxicity for flora and fauna in the human living environment → **Remain effective (including not highly persistent substances)**	- Mandatory reporting of planned and actual amounts manufactured and/or imported, usage, etc. - If deemed necessary, government issues orders to change the planned manufacture and import amounts - The government provides technical guidelines, recommendations for handling - Mandatory and recommended labeling
Type I Monitoring Chemical Substances (36 substances including cyclododecan) Existing chemical substances that are confirmed to be persistent and highly bioaccumulative → **Monitoring Chemical Substances**	- Mandatory reporting of actual amounts manufactured and/or imported, usage, etc. - Name of the substance and reported amounts of manufacturing and/or import is publicized by the government for the substances whose total volume is at least 1 ton. - Guidelines, advice, etc. (when necessary to prevent environmental pollution) - When necessary, the government directs manufacturers and importers to investigate long-term toxicity for humans or for predator animals at higher trophic level
Type II Monitoring Chemical Substances (952 substances including chloroform) Chemical substances that are not highly accumulative but are not readily biodegradable and suspected to have long-term toxicity → **Discontinued (Some substances are specified as Priority Assessment Chemical Substances)**	- Mandatory reporting of actual amounts manufactured and/or imported, usage, etc. - Name of the substance and reported amounts of manufacturing and/or import is publicized by the government for the substances whose total volume is at least 100 tons. - When necessary, government directs manufacturers and importers to investigate long-term toxicity for humans
Type III Monitoring Chemical Substances (157 substances including cadmium nitrate) Chemical substances that are persistent and have toxicity for general flora and fauna (ecotoxicity)	- Mandatory reporting of actual amounts manufactured and/or imported, usage, etc. - Name of the substance and reported amounts of manufacturing and/or import is publicized by the government for the substances whose total volume is at least 100 tons. - When necessary, the government directs manufacturers and importers to investigate long-term toxicity for flora and fauna in the human living environment

Priority Assessment Chemical Substances
(Sufficiently low risk of the substance cannot be confirmed)

General Chemical Substances
(Sufficiently low risk of the substance can be confirmed)

3. Specific Items of the Amendment

(1) First Phase of Amendment

(a) Readily biodegradable substances will be included

○ While only persistent chemical substances are classified into Class II Specified Chemical Substances, Type II Monitoring Chemical Substances, and Type III Monitoring Chemical Substances under the current Law, chemical substances that are readily biodegradable will become subject to control under the amended Law.

- More stringent control of the volume of manufacture and import of these substances is needed for chemical substances even when they are readily biodegradable . This is based in a concern that these substances impose adverse effects on humans or flora and fauna if released into the environment at the amount exceeding the degradable amount in the environment.
- The 2020 Goal of the WSSD requires establishment of a system for phase-by-phase implementation of safety assessment for all chemical substances distributed in Japan.
- European countries, the U.S. and other countries in the international community do not limit their regulation of chemical substances to persistent substances. Safety is ensured through measures including restrictions on manufacture and import that are determined based on the data on toxicity and the status of environmental release of chemical substances.

(b) Confirmation System for Polymers of Low Concern

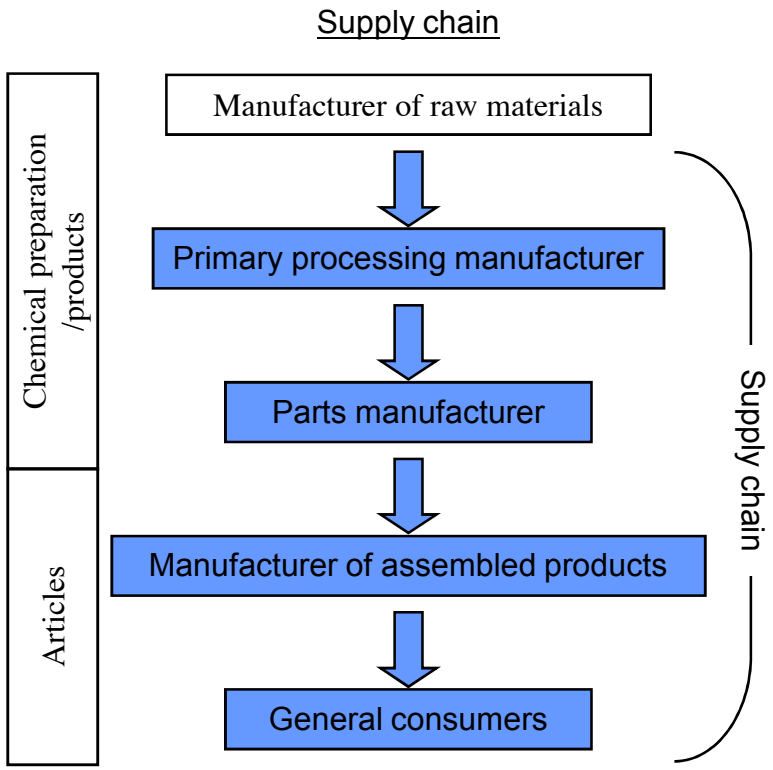
○ Polymers of Low Concern (PLCs) will be exempted from mandatory notification of manufacture and import for new chemical substances and will become subject to confirmation based on existing knowledge.

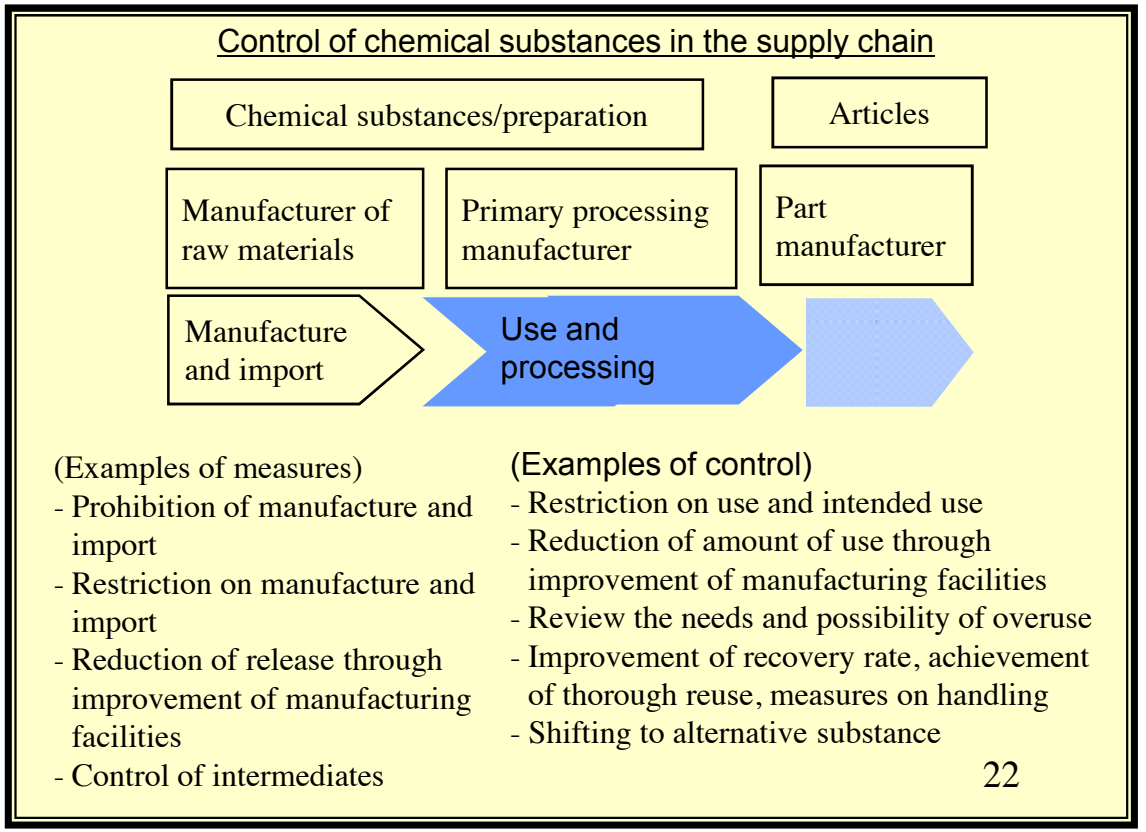
- Polymers (macromolecular compounds made of a number of low molecular compounds bonded) that meet a certain criteria do not penetrate the plasma membrane due to their high molecular weights, imposing low effects on human health and/or growth of plants and animals as validated by the international community.
- In the light of these circumstances, mandatory notification under the Chemical Substance Control Law may be exempted for the manufacture or import of a new chemical substance if the substance is a Polymer and is confirmed by the three relevant ministers to meet the criteria for “Polymers of Low Concern” (PLCs) that are not concerned to impose adverse effects on human health, inhabitation of plants and animals in the human living environment, etc prior to those manufacture or import.
- When specified as a PLC, the manufacturer or importer may be subject to obligatory report and on-site inspection.

(c) Information Delivery in the Supply Chain

○ When Type I Monitoring Chemical Substances are transferred between business entities, the entity transferring the substance is obliged to make utmost efforts to inform the recipient that the substance is specified as the Type I Monitoring Chemical Substance among other information.

○ For Class II Specified Chemical Substances and Type I Monitoring Chemical Substances, the three relevant ministries and ministers may instruct the business entity handling the substance to report the status of transaction.





(d) Measures concerning the Class I Specified Chemical Substances

○ Use of Class I Specified Chemical Substances are permitted as a case of “essential use” when substation to an alternative substance is very difficult and the substance does not impose adverse effects on human health or on the environment (mitigation of requirements).

○ Labeling and other identification and compliance with the standards are imposed as obligations concerning Class I Specified Chemical Substances and products containing such substances (enhancement of management).

< Summary of the Cabinet order >

- The 12 substances, including Perfluorooctane sulfonic acid and its salt forms (Perfluorooctane sulfonate: PFOS), that were specified by the Stockholm Convention in May 2009 will be designated as the Class I Specified Chemical Substances
- For PFOS, the use for manufacture of etching agent and resist for semiconductors and use for manufacture of industrial photo films will be designated as the authorized uses (designated as “essential uses”).
- For the purpose of environmental pollution prevention, etching agent and resist for semiconductors, industrial photo films and fire-extinguishing foam, etc. containing PFOS will be designated as products for which handling business entity is obliged to meet the handling standards and to apply proper labeling.
- Products containing the 12 substances described above will be designated as import prohibited items (additives for surface treatment agents for plating, aviation hydraulic fluids, etc.).

(Reference) Stockholm Convention

○ The Stockholm Convention, in order to protect human health and environment from Persistent Organic Pollutants (POPs), prohibits or restricts the manufacturing, use and international trade of chemical substances that are (1) toxic, (2) persistent, (3) bioaccumulative, and (4) having potential for long-range environmental transport.

○ In the COP4 in May 2009, twelve new substances, including PFOS, are newly designated as the substances subject to the convention.

- Currently, 9 substances are designated as substances for which specific measures are required.
  (Annex A: Elimination; Annex B: Restriction; Annex C: Unintentional production)
  (aldrin, chlordane, dieldrin, endrin, heptachlor, hexachlorobenzene, mirex, toxaphene, polychlorinated biphenyls, DDT, polychlorinated dibenzo-p-dioxins, and polychlorinated dibenzofurans)
- In the Chemical Substance Control Law of Japan, these substances, except for unintentional production, are designated as the Class I Specified Chemical Substances in the Law.

Stockholm Convention on persistent organic pollutants (POPs)

(e) Measures concerning the Class II Specified Chemical Substances

○ In the current Law, the government provides technical guidelines and recommendations to prevent environmental pollution for Class II Specified Chemical Substances. After the amendment, such technical guidelines and recommendations will be given for the products containing a Class II Specified Chemical Substance designated by cabinet order.

○ In the current Law, labeling for the products specified by cabinet order containing Class II Specified Chemical Substances are obliged to the business entities that handle Class II Specified Chemical Substances. After the amendment, such labeling will be also mandatory for business entities that handle products containing Class II Specified Chemical Substances.

(f) Other Measures (Notification for other laws and ordinances relevant)

<Notification to relevant ministries and agencies>

○ Control and management of chemical substances are subject to, in addition to the Chemical Substance Control Law, the Poisonous and Deleterious Substances Control Act, the Industrial Safety and Health Act, the Pharmaceutical Affairs Act, the Air Pollution Control Law, and the Water Pollution Control Act among others.

○ In the current Chemical Substance Control Law, information on toxicity for new chemical substances can be collected before the substance is launched on the market. When new findings are obtained regarding the properties, etc. of the chemical substance based on the Chemical Substance Control Law, such findings are notified to the relevant ministries and/or agencies.

<Collection of information and on-site inspection>

○ The range of collection of information and on-site inspection is extended to business entities that handle the products containing the Class I Specified Chemical Substances designated by Cabinet order.

<Guideline and advice>

○ The range of guideline and advice by the government is extended to include the business entities that handle products containing the Class II Specified Chemical Substances designated by Cabinet order.

(2) Second Phase of Amendment

(a) Notification of the amount of manufacturing or import for general chemical substances

○ Companies that manufacture or import 1 ton or more of chemical substances must notify the amount of manufacturing or import, use and other information for each fiscal year.

○ Notified chemical substances are assessed for their risk, and designated as a PACs (Priority Assessment Chemical Substances), if necessary.

- Substances exempted from mandatory notification will be limited to (1) chemical substances used for research purposes, (2) chemical substances less than 1 ton in volume, and (3) chemical substances that are known to impose low risk (e.g., water and carbon dioxide).
- When toxicity information that has not been publicly known is obtained for substances that are subject to notification, such information must be reported to the three ministries (the Ministry of Economy, Trade and Industry; Ministry of Health, Labour and Welfare; and Ministry of the Environment).
- Notification for the Specified Chemical Substances, the PACs, and the Monitoring Chemical Substances will be carried out according to each regulation and therefore not necessary for this regulation.

(b) Priority Assessment Chemical Substances (New Category)

- ○ Chemical substances that are deemed as high risk are designated from those subject to notification as PACs(Priority Assessment Chemical Substances)
- ○ Companies that manufacture or import any of the PACs at volume of 1 ton or higher are obliged to notify the amount of manufacture or import, usage and other information for each year
- ○ Detailed risk assessment will be carried out in a stepwise manner, and, when found necessary; the substance will be designated as a Class II Specified Chemical Substance if necessary.
- ○ When publicly unknown information is obtained, it must be notified to the three relevant ministries (“obligation to use best efforts”).
- ○ Manufacturers, importers and users of the PACs have the following obligations, etc. as listed below.

(1) Manufacturers and importers:
- Manufacturers and importers are obliged to report the amount of manufacture and/or import, as well as the usage of the substances
- Manufacturers and importers are obliged to make best efforts to disclose information obtained through the supply chain
- The government may request the manufacturers and importers to carry out simple toxicity tests
- The government may instruct the manufacturers and importers to submit toxicity data

(2) Users:
- Companies that use these substances are obliged to make their best efforts to notify relevant information
- The government may request the companies to report the handling status

(c) Handling of the Monitoring Chemical Substances

○ Classifications of Type II Monitoring Chemical Substances and Type III Monitoring Chemical Substances are to be discontinued after the PACs (Priority Assessment Chemical Substances) are established

○ Classification of Type I Monitoring Chemical Substances will be renamed “Monitoring Chemical Substances” and remain effective

- Under the system of Type II Monitoring Chemical Substances, chemical substances that pose a risk of harming human health are designated and the manufacturers and importers of such substances are requested to report the amount of manufacture or import
- Under the system of Type III Monitoring Chemical Substances, chemical substances that have a risk of imposing adverse effects on the habitats of or the growth of plants and animals are designated and the manufacturers and importers of such substances are requested to report the amount of manufacture or import
- Classifications of Type II and Type III Monitoring Chemical Substances are to be discontinued after the new classification of the PACs is made effective under the amended Law in order to assess the toxicity of the substances to human health and flora and fauna
- The classification of Type I Monitoring Chemical Substances, the “predecessor” of Class I Specified Chemical Substances

4. Order for Enforcement of the Amended Chemical Substance Control Law

Order for Enforcement of the Amended Chemical Substance Control Law: Overview

1. Items related to Specified Chemical Substances

(1) Addition of new substances to Class I Specified Chemical Substances

- 12 substances subject to the Stockholm Convention are designated as substances to be added to the class

(2) Addition of products containing a Class I Specified Chemical Substance for import prohibited items

- Products that contain a Class I Specified Chemical Substance and cause environmental pollution are prohibited for import
  (12 products containing 3 substances, including PFOS, are designated)

(3) Designation of certain Class I Specified Chemical Substances for an exceptional usage (essential use)

- When a certain substance classified in the Class I Specified Chemical Substance is essential for the manufacturing of a product, the use of such substance may be permitted as an exception if technical standards and labeling obligations are met
  (3 Usages are designated for PFOS. (Use of foam distinguisher agents is not designated as a usage essential for manufacturing but technical standards and mandatory labeling are imposed on their use.)

(4) Designation of products containing Class II Specified Chemical Substances

- Compliance with the technical guidelines are newly imposed on the products containing a Class II Specified Chemical Substance
- Handling companies of products containing a Class II Specified Chemical Substance are obliged to conduct mandatory labeling
  (8 products containing 3 substances are designated)

2. Notification of general chemical substances, etc.

- The minimum amount of manufacture or import of general chemical substances and the Priority Assessment Chemical Substances subject to notification is set as 1 ton/fiscal year/company

Reference: Dates of enforcement (Date of promulgation: October 30th, 2009)

- April 1st, 2010: → Class I Specified Chemical Substances are to be added. Essential uses are to be added. Products containing Class II Specified Chemical Substances are to be designated
- May 1st, 2010: → Import of prohibited products are to be added
- October 1st, 2010: → Obligation to meet the standards and mandatory labeling for products containing a Class I Specified Chemical Substance
- April 1st, 2011: → Notification of general chemical substances and Priority Assessment Chemical Substances

(Reference (1)) Order for Enforcement of the Amended Chemical Substance Control Law

1. Class I Specified Chemical Substances

(1) Perfluorooctane sulfonate (PFOS) or its salts
(2) Erfluorooctane sulfonyl fluoride (PFOSF)
(3) Pentachlorobenzene
(4) r-1, c-2, t-3, c-4, t-5, t-6- hexachlorocyclohexane (i.e., α-hexachlorocyclohexane)
(5) r-1, t-2, c-3, t-4, c-5, t-6- hexachlorocyclohexane (i.e., β-hexachlorocyclohexane)
(6) r-1, c-2, t-3, c-4, c-5, t-6- hexachlorocyclohexane (i.e., γ-hexachlorocyclohexane)
(7) Decachloropentacyclo [5. 3. 0. $0^{2,6}$. $0^{3,9}$, $0^{4,8}$] decane-5-one (i.e., chlordecone)
(8) Hexabromobiphenyl
(9) Tetrabromo (phenoxybenzene) (i.e., tetrabromodiphenyl ether)
(10) Pentabromo (phenoxybenzene) (i.e., pentabromodiphenyl ether)
(11) Hexabromo (phenoxybenzene) (i.e., hexabromodiphenyl ether)
(12) Heptabromo (phenoxybenzene) (i.e., heptabromodiphenyl ether)

2. Import prohibited products

<PFOS or its salts>

(1) Aviation hydraulic fluids
(2) Treating agents for yarn
(3) Etching agents for metal processing
(4) Etching agents for semiconductors (excluding high-frequency compound semiconductors to allow radio equipment to transmit waves of 3 megahertz or higher)
(5) Surface treating agents for metal plating or additives to prepare the agents
(6) Anti-reflective coatings for semiconductors
(7) Abrasive compounds
(8) Fire extinguishers, agents for fire extinguishers, and fire-extinguishing foam
(9) Insecticides for termites and termite repellents
(10) Printing paper

<Tetrabromodiphenyl ether, pentabromodiphenyl ether>

(1) Paints
(2) Adhesives

(Reference (2)) Order for Enforcement of the Amended Chemical Substance Control Law

3. Essential uses of Class I Specified Chemical Substances

<PFOS or its salts>

(1) Manufacture of etching agents for semiconductors (limited to voltage filters and high-frequency compound semiconductors to allow radio equipment to transmit waves of 3 megahertz or higher)
(2) Manufacture of semiconductor resists
(3) Manufacture of photo films for industrial purposes

4. Products containing a Class I Specified Chemical Substance that is subject to obligation to meet technical standards and mandatory labeling

<PFOS or its salts>

(1) Etching agents for semiconductors (limited to voltage filters and high-frequency compound semiconductors to allow radio equipment to transmit waves of 3 megahertz or higher.)
(2) Semiconductor resists
(3) Photo films for industrial purposes
(4) Fire extinguishers, agents for fire extinguishers, and fire-extinguishing foam

5. Products containing a Class II Specified Chemical Substance that is subject to obligation to meet technical standards and mandatory labeling

<Trichloroethylene>

(1) Adhesives (excluding adhesives of animal or plant origins)
(2) Paints (excluding water-based paints)
(3) Metal processing oil
(4) Detergents

<Tetrachloroethylene>

(1) Vulcanizing agents
(2) Adhesives (excluding adhesives of animal or plant origins)
(3) Paints (excluding water-based paints)
(4) Detergents
(5) Finishing/processing agents for fiber products

<Tributyltine compounds>

(1) Antiseptic agents and anti-mold agents
(2) Paints (limited to paints used to prevent live growth of crustaceans, algae and other aquatic life on the hulls)

Useful URLs for the Information on the Chemical Substance Control Law

<Ministry of Economy, Trade and Industry>
http://www.meti.go.jp/policy/chemical_management/index.html

<Ministry of the Environment>
http://www.env.go.jp/chemi/kagaku/index.html

<Ministry of Health, Labour and Welfare>
http://www.nihs.go.jp/mhlw/chemical/kashin/kashin.html

<Public Comment (Ministry of Economy, Trade and Industry)>
http://www.meti.go.jp/feedback/index.html

Thank you.

Part 260 -- GUIDES FOR THE USE OF ENVIRONMENTAL MARKETING CLAIMS

sec.

Authority: 15 U.S.C. §§ 41-58

§ 260.1 Statement of purpose

These guides represent administrative interpretations of laws administered by the Federal Trade Commission for the guidance of the public in conducting its affairs in conformity with legal requirements. These guides specifically address the application of Section 5 of the FTC Act to environmental advertising and marketing practices. They provide the basis for voluntary compliance with such laws by members of industry. Conduct inconsistent with the positions articulated in these guides may result in corrective action by the Commission under Section 5 if, after investigation, the Commission has reason to believe that the behavior falls within the scope of conduct declared unlawful by the statute.

§ 260.2 Scope of guides

These guides apply to environmental claims included in labeling, advertising, promotional materials and all other forms of marketing, whether asserted directly or by implication, through words, symbols, emblems, logos, depictions, product brand names, or through any other means, including marketing through digital or electronic means, such as the Internet or electronic mail. The guides apply to any claim about the environmental attributes of a product, package or service in connection with the sale, offering for sale, or marketing of such product, package or service for personal, family or household use, or for commercial, institutional or industrial use.

Because the guides are not legislative rules under Section 18 of the FTC Act, they are not themselves enforceable regulations, nor do they have the force and effect of law. The guides themselves do not preempt regulation of other federal agencies or of state and local bodies governing the use of environmental marketing claims. Compliance with federal, state or local law and regulations concerning such claims, however, will not necessarily preclude Commission law enforcement action

under Section 5.

§ 260.3 Structure of the guides

The guides are composed of general principles and specific guidance on the use of environmental claims. These general principles and specific guidance are followed by examples that generally address a single deception concern. A given claim may raise issues that are addressed under more than one example and in more than one section of the guides.

In many of the examples, one or more options are presented for qualifying a claim. These options are intended to provide a "safe harbor" for marketers who want certainty about how to make environmental claims. They do not represent the only permissible approaches to qualifying a claim. The examples do not illustrate all possible acceptable claims or disclosures that would be permissible under Section 5. In addition, some of the illustrative disclosures may be appropriate for use on labels but not in print or broadcast advertisements and vice versa. In some instances, the guides indicate within the example in what context or contexts a particular type of disclosure should be considered.

§ 260.4 Review procedure

The Commission will review the guides as part of its general program of reviewing all industry guides on an ongoing basis. Parties may petition the Commission to alter or amend these guides in light of substantial new evidence regarding consumer interpretation of a claim or regarding substantiation of a claim. Following review of such a petition, the Commission will take such action as it deems appropriate.

§ 260.5 Interpretation and substantiation of environmental marketing claims

Section 5 of the FTC Act makes unlawful deceptive acts and practices in or affecting commerce. The Commission's criteria for determining whether an express or implied claim has been made are enunciated in the Commission's Policy Statement on Deception.(1) In addition, any party making an express or implied claim that presents an objective assertion about the environmental attribute of a product, package or service must, at the time the claim is made, possess and rely upon a reasonable basis substantiating the claim. A reasonable basis consists of competent and reliable evidence. In the context of environmental marketing claims, such substantiation will often require competent and reliable scientific evidence, defined as tests, analyses, research, studies or other evidence based on the expertise of professionals in the relevant area, conducted and evaluated in an objective manner by persons qualified to do so, using procedures generally accepted in the profession to yield accurate and reliable results. Further guidance on the reasonable basis standard is set forth in the Commission's 1983 Policy Statement on the Advertising Substantiation Doctrine. 49 Fed. Reg. 30999 (1984); *appended to Thompson Medical Co.*, 104 F.T.C. 648 (1984). The Commission has also taken action in a number of cases involving alleged deceptive or unsubstantiated environmental advertising claims. A current list of environmental marketing cases and/or copies of individual cases can be obtained by calling the FTC Consumer Response Center at (202) 326-2222 (202) 326-2222 .

§ 260.6 General principles

The following general principles apply to all environmental marketing claims, including, but not limited to, those described in § 260.7. In addition, § 260.7 contains specific guidance applicable to certain environmental marketing claims. Claims should comport with all relevant provisions of these guides, not simply the provision that seems most directly applicable.

(a) *Qualifications and disclosures*: The Commission traditionally has held that in order to be effective, any qualifications or disclosures such as those described in these guides should be sufficiently clear, prominent and understandable to prevent deception. Clarity of language, relative type size and proximity to the claim being qualified, and an absence of contrary claims that could undercut effectiveness, will maximize the likelihood that the qualifications and disclosures are appropriately clear and prominent.

***(b) Distinction between benefits of product, package and service*:** An environmental marketing claim should be presented in a way that makes clear whether the environmental attribute or benefit being asserted refers to the product, the product's packaging, a service or to a portion or component of the product, package or service. In general, if the environmental attribute or benefit applies to all but minor, incidental components of a product or package, the claim need not be qualified to identify that fact. There may be exceptions to this general principle. For example, if an unqualified "recyclable" claim is made and the presence of the incidental component significantly limits the ability to recycle the product, then the claim would be deceptive.

Example 1:

A box of aluminum foil is labeled with the claim "recyclable," without further elaboration. Unless the type of product, surrounding language, or other context of the phrase establishes whether the claim refers to the foil or the box, the claim is deceptive if any part of either the box or the foil, other than minor, incidental components, cannot be recycled.

Example 2:

A soft drink bottle is labeled "recycled." The bottle is made entirely from recycled materials, but the bottle cap is not. Because reasonable consumers are likely to consider the bottle cap to be a minor, incidental component of the package, the claim is not deceptive. Similarly, it would not be deceptive to label a shopping bag "recycled" where the bag is made entirely of recycled material but the easily detachable handle, an incidental component, is not.

(c) *Overstatement of environmental attribute*: An environmental marketing claim should not be presented in a manner that overstates the environmental attribute or benefit, expressly or by implication. Marketers should avoid implications of significant environmental benefits if the benefit is in fact negligible.

Example 1:

A package is labeled, "50% more recycled content than before." The manufacturer increased the

recycled content of its package from 2 percent recycled material to 3 percent recycled material. Although the claim is technically true, it is likely to convey the false impression that the advertiser has increased significantly the use of recycled material.

Example 2:

A trash bag is labeled "recyclable" without qualification. Because trash bags will ordinarily not be separated out from other trash at the landfill or incinerator for recycling, they are highly unlikely to be used again for any purpose. Even if the bag is technically capable of being recycled, the claim is deceptive since it asserts an environmental benefit where no significant or meaningful benefit exists.

Example 3:

A paper grocery sack is labeled "reusable." The sack can be brought back to the store and reused for carrying groceries but will fall apart after two or three reuses, on average. Because reasonable consumers are unlikely to assume that a paper grocery sack is durable, the unqualified claim does not overstate the environmental benefit conveyed to consumers. The claim is not deceptive and does not need to be qualified to indicate the limited reuse of the sack.

Example 4:

A package of paper coffee filters is labeled "These filters were made with a chlorine-free bleaching process." The filters are bleached with a process that releases into the environment a reduced, but still significant, amount of the same harmful byproducts associated with chlorine bleaching. The claim is likely to overstate the product's benefits because it is likely to be interpreted by consumers to mean that the product's manufacture does not cause any of the environmental risks posed by chlorine bleaching. A claim, however, that the filters were "bleached with a process that substantially reduces, but does not eliminate, harmful substances associated with chlorine bleaching" would not, if substantiated, overstate the product's benefits and is unlikely to be deceptive.

(d) *Comparative claims*: Environmental marketing claims that include a comparative statement should be presented in a manner that makes the basis for the comparison sufficiently clear to avoid consumer deception. In addition, the advertiser should be able to substantiate the comparison.

Example 1:

An advertiser notes that its shampoo bottle contains "20% more recycled content." The claim in its context is ambiguous. Depending on contextual factors, it could be a comparison either to the advertiser's immediately preceding product or to a competitor's product. The advertiser should clarify the claim to make the basis for comparison clear, for example, by saying "20% more recycled content than our previous package." Otherwise, the advertiser should be prepared to substantiate whatever comparison is conveyed to reasonable consumers.

Example 2:

An advertiser claims that "our plastic diaper liner has the most recycled content." The advertised diaper does have more recycled content, calculated as a percentage of weight, than any other on the market, although it is still well under 100% recycled. Provided the recycled content and the comparative difference between the product and those of competitors are significant and provided the specific comparison can be substantiated, the claim is not deceptive.

Example 3:

An ad claims that the advertiser's packaging creates "less waste than the leading national brand." The advertiser's source reduction was implemented sometime ago and is supported by a calculation comparing the relative solid waste contributions of the two packages. The advertiser

should be able to substantiate that the comparison remains accurate.

§ 260.7 Environmental marketing claims

Guidance about the use of environmental marketing claims is set forth below. Each guide is followed by several examples that illustrate, but do not provide an exhaustive list of, claims that do and do not comport with the guides. In each case, the general principles set forth in § 260.6 should also be followed.(2)

***(a) General environmental benefit claims*:** It is deceptive to misrepresent, directly or by implication, that a product, package or service offers a general environmental benefit. Unqualified general claims of environmental benefit are difficult to interpret, and depending on their context, may convey a wide range of meanings to consumers. In many cases, such claims may convey that the product, package or service has specific and far-reaching environmental benefits. As explained in the Commission's Advertising Substantiation Statement, every express and material implied claim that the general assertion conveys to reasonable consumers about an objective quality, feature or attribute of a product or service must be substantiated. Unless this substantiation duty can be met, broad environmental claims should either be avoided or qualified, as necessary, to prevent deception about the specific nature of the environmental benefit being asserted.

Example 1:

A brand name like "Eco-Safe" would be deceptive if, in the context of the product so named, it leads consumers to believe that the product has environmental benefits which cannot be substantiated by the manufacturer. The claim would not be deceptive if "Eco-Safe" were followed by clear and prominent qualifying language limiting the safety representation to a particular product attribute for which it could be substantiated, and provided that no other deceptive implications were created by the context.

Example 2:

A product wrapper is printed with the claim "Environmentally Friendly." Textual comments on the wrapper explain that the wrapper is "Environmentally Friendly because it was not chlorine bleached, a process that has been shown to create harmful substances." The wrapper was, in fact, not bleached with chlorine. However, the production of the wrapper now creates and releases to the environment significant quantities of other harmful substances. Since consumers are likely to interpret the "Environmentally Friendly" claim, in combination with the textual explanation, to mean that no significant harmful substances are currently released to the environment, the "Environmentally Friendly" claim would be deceptive.

Example 3:

A pump spray product is labeled "environmentally safe." Most of the product's active ingredients consist of volatile organic compounds (VOCs) that may cause smog by contributing to ground-level ozone formation. The claim is deceptive because, absent further qualification, it is likely to convey to consumers that use of the product will not result in air pollution or other harm to the environment.

Example 4:

A lawn care pesticide is advertised as "essentially non-toxic" and "practically non-toxic." Consumers would likely interpret these claims in the context of such a product as applying not

only to human health effects but also to the product's environmental effects. Since the claims would likely convey to consumers that the product does not pose any risk to humans or the environment, if the pesticide in fact poses a significant risk to humans or environment, the claims would be deceptive.

Example 5:

A product label contains an environmental seal, either in the form of a globe icon, or a globe icon with only the text "Earth Smart" around it. Either label is likely to convey to consumers that the product is environmentally superior to other products. If the manufacturer cannot substantiate this broad claim, the claim would be deceptive. The claims would not be deceptive if they were accompanied by clear and prominent qualifying language limiting the environmental superiority representation to the particular product attribute or attributes for which they could be substantiated, provided that no other deceptive implications were created by the context.

Example 6:

A product is advertised as "environmentally preferable." This claim is likely to convey to consumers that this product is environmentally superior to other products. If the manufacturer cannot substantiate this broad claim, the claim would be deceptive. The claim would not be deceptive if it were accompanied by clear and prominent qualifying language limiting the environmental superiority representation to the particular product attribute or attributes for which it could be substantiated, provided that no other deceptive implications were created by the context.

(b) ***Degradable/biodegradable/photodegradable*****:** It is deceptive to misrepresent, directly or by implication, that a product or package is degradable, biodegradable or photodegradable. An unqualified claim that a product or package is degradable, biodegradable or photodegradable should be substantiated by competent and 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.

Claims of degradability, biodegradability or photodegradability should be qualified to the extent necessary to avoid consumer deception about: (1) the product or package's ability to degrade in the environment where it is customarily disposed; and (2) the rate and extent of degradation.

Example 1:

A trash bag is marketed as "degradable," with no qualification or other disclosure. The marketer relies on soil burial tests to show that the product will decompose in the presence of water and oxygen. The trash bags are customarily disposed of in incineration facilities or at sanitary landfills that are managed in a way that inhibits degradation by minimizing moisture and oxygen. Degradation will be irrelevant for those trash bags that are incinerated and, for those disposed of in landfills, the marketer does not possess adequate substantiation that the bags will degrade in a reasonably short period of time in a landfill. The claim is therefore deceptive.

Example 2:

A commercial agricultural plastic mulch film is advertised as "Photodegradable" and qualified with the phrase, "Will break down into small pieces if left uncovered in sunlight." The claim is supported by competent and reliable scientific evidence that the product will break down in a reasonably short period of time after being exposed to sunlight and into sufficiently small pieces to become part of the soil. The qualified claim is not deceptive. Because the claim is qualified to

indicate the limited extent of breakdown, the advertiser need not meet the elements for an unqualified photodegradable claim, i.e., that the product will not only break down, but also will decompose into elements found in nature.

Example 3:

A soap or shampoo product is advertised as "biodegradable," with no qualification or other disclosure. The manufacturer has competent and reliable scientific evidence demonstrating that the product, which is customarily disposed of in sewage systems, will break down and decompose into elements found in nature in a short period of time. The claim is not deceptive.

Example 4:

A plastic six-pack ring carrier is marked with a small diamond. Many state laws require that plastic six-pack ring carriers degrade if littered, and several state laws also require that the carriers be marked with a small diamond symbol to indicate that they meet performance standards for degradability. The use of the diamond, by itself, does not constitute a claim of degradability.(3)

(c) Compostable: It is deceptive to misrepresent, directly or by implication, that a product or package is compostable. A claim that a product or package is compostable should be substantiated by competent and reliable scientific evidence that all the materials in the product or package will break down into, or otherwise become part of, usable compost (e.g., soil-conditioning material, mulch) in a safe and timely manner in an appropriate composting program or facility, or in a home compost pile or device. Claims of compostability should be qualified to the extent necessary to avoid consumer deception. An unqualified claim may be deceptive if: (1) the package cannot be safely composted in a home compost pile or device; or (2) the claim misleads consumers about the environmental benefit provided when the product is disposed of in a landfill. A claim that a product is compostable in a municipal or institutional composting facility may need to be qualified to the extent necessary to avoid deception about the limited availability of such composting facilities.

Example 1:

A manufacturer indicates that its unbleached coffee filter is compostable. The unqualified claim is not deceptive provided the manufacturer can substantiate that the filter can be converted safely to usable compost in a timely manner in a home compost pile or device. If this is the case, it is not relevant that no local municipal or institutional composting facilities exist.

Example 2:

A lawn and leaf bag is labeled as "Compostable in California Municipal Yard Trimmings Composting Facilities." The bag contains toxic ingredients that are released into the compost material as the bag breaks down. The claim is deceptive if the presence of these toxic ingredients prevents the compost from being usable.

Example 3:

A manufacturer makes an unqualified claim that its package is compostable. Although municipal or institutional composting facilities exist where the product is sold, the package will not break down into usable compost in a home compost pile or device. To avoid deception, the manufacturer should disclose that the package is not suitable for home composting.

Example 4:

A nationally marketed lawn and leaf bag is labeled "compostable." Also printed on the bag is a

disclosure that the bag is not designed for use in home compost piles. The bags are in fact composted in yard trimmings composting programs in many communities around the country, but such programs are not available to a substantial majority of consumers or communities where the bag is sold. The claim is deceptive because reasonable consumers living in areas not served by yard trimmings programs may understand the reference to mean that composting facilities accepting the bags are available in their area. To avoid deception, the claim should be qualified to indicate the limited availability of such programs, for example, by stating, "Appropriate facilities may not exist in your area." Other examples of adequate qualification of the claim include providing the approximate percentage of communities or the population for which such programs are available.

Example 5:

A manufacturer sells a disposable diaper that bears the legend, "This diaper can be composted where solid waste composting facilities exist. There are currently [X number of] solid waste composting facilities across the country." The claim is not deceptive, assuming that composting facilities are available as claimed and the manufacturer can substantiate that the diaper can be converted safely to usable compost in solid waste composting facilities.

Example 6:

A manufacturer markets yard trimmings bags only to consumers residing in particular geographic areas served by county yard trimmings composting programs. The bags meet specifications for these programs and are labeled, "Compostable Yard Trimmings Bag for County Composting Programs." The claim is not deceptive. Because the bags are compostable where they are sold, no qualification is required to indicate the limited availability of composting facilities.

***(d) Recyclable**:* It is deceptive to misrepresent, directly or by implication, that a product or package is recyclable. A product or package should not be marketed as recyclable unless it can be collected, separated or otherwise recovered from the solid waste stream for reuse, or in the manufacture or assembly of another package or product, through an established recycling program. Unqualified claims of recyclability for a product or package may be made if the entire product or package, excluding minor incidental components, is recyclable. For products or packages that are made of both recyclable and non-recyclable components, the recyclable claim should be adequately qualified to avoid consumer deception about which portions or components of the product or package are recyclable. Claims of recyclability should be qualified to the extent necessary to avoid consumer deception about any limited availability of recycling programs and collection sites. If an incidental component significantly limits the ability to recycle a product or package, a claim of recyclability would be deceptive. A product or package that is made from recyclable material, but, because of its shape, size or some other attribute, is not accepted in recycling programs for such material, should not be marketed as recyclable.(4)

Example 1:

A packaged product is labeled with an unqualified claim, "recyclable." It is unclear from the type of product and other context whether the claim refers to the product or its package. The unqualified claim is likely to convey to reasonable consumers that all of both the product and its packaging that remain after normal use of the product, except for minor, incidental components, can be recycled. Unless each such message can be substantiated, the claim should be qualified to indicate what portions are recyclable.

Example 2:

A nationally marketed 8 oz. plastic cottage-cheese container displays the Society of the Plastics Industry (SPI) code (which consists of a design of arrows in a triangular shape containing a number and abbreviation identifying the component plastic resin) on the front label of the container, in close proximity to the product name and logo. The manufacturer's conspicuous use of the SPI code in this manner constitutes a recyclability claim. Unless recycling facilities for this container are available to a substantial majority of consumers or communities, the claim should be qualified to disclose the limited availability of recycling programs for the container. If the SPI code, without more, had been placed in an inconspicuous location on the container (e.g., embedded in the bottom of the container) it would not constitute a claim of recyclability.

Example 3:

A container can be burned in incinerator facilities to produce heat and power. It cannot, however, be recycled into another product or package. Any claim that the container is recyclable would be deceptive.

Example 4:

A nationally marketed bottle bears the unqualified statement that it is "recyclable." Collection sites for recycling the material in question are not available to a substantial majority of consumers or communities, although collection sites are established in a significant percentage of communities or available to a significant percentage of the population. The unqualified claim is deceptive because, unless evidence shows otherwise, reasonable consumers living in communities not served by programs may conclude that recycling programs for the material are available in their area. To avoid deception, the claim should be qualified to indicate the limited availability of programs, for example, by stating "This bottle may not be recyclable in your area," or "Recycling programs for this bottle may not exist in your area." Other examples of adequate qualifications of the claim include providing the approximate percentage of communities or the population to whom programs are available.

Example 5:

A paperboard package is marketed nationally and labeled, "Recyclable where facilities exist." Recycling programs for this package are available in a significant percentage of communities or to a significant percentage of the population, but are not available to a substantial majority of consumers. The claim is deceptive because, unless evidence shows otherwise, reasonable consumers living in communities not served by programs that recycle paperboard packaging may understand this phrase to mean that such programs are available in their area. To avoid deception, the claim should be further qualified to indicate the limited availability of programs, for example, by using any of the approaches set forth in Example 4 above.

Example 6:

A foam polystyrene cup is marketed as follows: "Recyclable in the few communities with facilities for foam polystyrene cups." Collection sites for recycling the cup have been established in a half-dozen major metropolitan areas. This disclosure illustrates one approach to qualifying a claim adequately to prevent deception about the limited availability of recycling programs where collection facilities are not established in a significant percentage of communities or available to a significant percentage of the population. Other examples of adequate qualification of the claim include providing the number of communities with programs, or the percentage of communities or the population to which programs are available.

Example 7:

A label claims that the package "includes some recyclable material." The package is composed of four layers of different materials, bonded together. One of the layers is made from the

recyclable material, but the others are not. While programs for recycling this type of material are available to a substantial majority of consumers, only a few of those programs have the capability to separate the recyclable layer from the non-recyclable layers. Even though it is technologically possible to separate the layers, the claim is not adequately qualified to avoid consumer deception. An appropriately qualified claim would be, "includes material recyclable in the few communities that collect multi-layer products." Other examples of adequate qualification of the claim include providing the number of communities with programs, or the percentage of communities or the population to which programs are available.

Example 8:

A product is marketed as having a "recyclable" container. The product is distributed and advertised only in Missouri. Collection sites for recycling the container are available to a substantial majority of Missouri residents, but are not yet available nationally. Because programs are generally available where the product is marketed, the unqualified claim does not deceive consumers about the limited availability of recycling programs.

Example 9:

A manufacturer of one-time use photographic cameras, with dealers in a substantial majority of communities, collects those cameras through all of its dealers. After the exposed film is removed for processing, the manufacturer reconditions the cameras for resale and labels them as follows: "Recyclable through our dealership network." This claim is not deceptive, even though the cameras are not recyclable through conventional curbside or drop off recycling programs.

Example 10:

A manufacturer of toner cartridges for laser printers has established a recycling program to recover its cartridges exclusively through its nationwide dealership network. The company advertises its cartridges nationally as "Recyclable. Contact your local dealer for details." The company's dealers participating in the recovery program are located in a significant number -- but not a substantial majority -- of communities. The "recyclable" claim is deceptive unless it contains one of the qualifiers set forth in Example 4. If participating dealers are located in only a few communities, the claim should be qualified as indicated in Example 6.

Example 11:

An aluminum beverage can bears the statement "Please Recycle." This statement is likely to convey to consumers that the package is recyclable. Because collection sites for recycling aluminum beverage cans are available to a substantial majority of consumers or communities, the claim does not need to be qualified to indicate the limited availability of recycling programs.

(e) ***Recycled content*****:** A recycled content claim may be made only for materials that have been recovered or otherwise diverted from the solid waste stream, either during the manufacturing process (pre-consumer), or after consumer use (post-consumer). To the extent the source of recycled content includes pre-consumer material, the manufacturer or advertiser must have substantiation for concluding that the pre-consumer material would otherwise have entered the solid waste stream. In asserting a recycled content claim, distinctions may be made between pre-consumer and post-consumer materials. Where such distinctions are asserted, any express or implied claim about the specific pre-consumer or post-consumer content of a product or package must be substantiated.

It is deceptive to misrepresent, directly or by implication, that a product or package is made of recycled material, which includes recycled raw material, as well as used,(5) reconditioned and remanufactured

components. Unqualified claims of recycled content may be made if the entire product or package, excluding minor, incidental components, is made from recycled material. For products or packages that are only partially made of recycled material, a recycled claim should be adequately qualified to avoid consumer deception about the amount, by weight, of recycled content in the finished product or package. Additionally, for products that contain used, reconditioned or remanufactured components, a recycled claim should be adequately qualified to avoid consumer deception about the nature of such components. No such qualification would be necessary in cases where it would be clear to consumers from the context that a product's recycled content consists of used, reconditioned or remanufactured components.

Example 1:

A manufacturer routinely collects spilled raw material and scraps left over from the original manufacturing process. After a minimal amount of reprocessing, the manufacturer combines the spills and scraps with virgin material for use in further production of the same product. A claim that the product contains recycled material is deceptive since the spills and scraps to which the claim refers are normally reused by industry within the original manufacturing process, and would not normally have entered the waste stream.

Example 2:

A manufacturer purchases material from a firm that collects discarded material from other manufacturers and resells it. All of the material was diverted from the solid waste stream and is not normally reused by industry within the original manufacturing process. The manufacturer includes the weight of this material in its calculations of the recycled content of its products. A claim of recycled content based on this calculation is not deceptive because, absent the purchase and reuse of this material, it would have entered the waste stream.

Example 3:

A greeting card is composed 30% by fiber weight of paper collected from consumers after use of a paper product, and 20% by fiber weight of paper that was generated after completion of the paper-making process, diverted from the solid waste stream, and otherwise would not normally have been reused in the original manufacturing process. The marketer of the card may claim either that the product "contains 50% recycled fiber," or may identify the specific pre-consumer and/or post-consumer content by stating, for example, that the product "contains 50% total recycled fiber, including 30% post-consumer."

Example 4:

A paperboard package with 20% recycled fiber by weight is labeled as containing "20% recycled fiber." Some of the recycled content was composed of material collected from consumers after use of the original product. The rest was composed of overrun newspaper stock never sold to customers. The claim is not deceptive.

Example 5:

A product in a multi-component package, such as a paperboard box in a shrink-wrapped plastic cover, indicates that it has recycled packaging. The paperboard box is made entirely of recycled material, but the plastic cover is not. The claim is deceptive since, without qualification, it suggests that both components are recycled. A claim limited to the paperboard box would not be deceptive.

Example 6:

A package is made from layers of foil, plastic, and paper laminated together, although the layers are indistinguishable to consumers. The label claims that "one of the three layers of this package

is made of recycled plastic." The plastic layer is made entirely of recycled plastic. The claim is not deceptive provided the recycled plastic layer constitutes a significant component of the entire package.

Example 7:

A paper product is labeled as containing "100% recycled fiber." The claim is not deceptive if the advertiser can substantiate the conclusion that 100% by weight of the fiber in the finished product is recycled.

Example 8:

A frozen dinner is marketed in a package composed of a cardboard box over a plastic tray. The package bears the legend, "package made from 30% recycled material." Each packaging component amounts to one-half the weight of the total package. The box is 20% recycled content by weight, while the plastic tray is 40% recycled content by weight. The claim is not deceptive, since the average amount of recycled material is 30%.

Example 9:

A paper greeting card is labeled as containing 50% recycled fiber. The seller purchases paper stock from several sources and the amount of recycled fiber in the stock provided by each source varies. Because the 50% figure is based on the annual weighted average of recycled material purchased from the sources after accounting for fiber loss during the production process, the claim is permissible.

Example 10:

A packaged food product is labeled with a three-chasing-arrows symbol without any further explanatory text as to its meaning. By itself, the symbol is likely to convey that the packaging is both "recyclable" and is made entirely from recycled material. Unless both messages can be substantiated, the claim should be qualified as to whether it refers to the package's recyclability and/or its recycled content. If a "recyclable claim" is being made, the label may need to disclose the limited availability of recycling programs for the package. If a recycled content claim is being made and the packaging is not made entirely from recycled material, the label should disclose the percentage of recycled content.

Example 11:

A laser printer toner cartridge containing 25% recycled raw materials and 40% reconditioned parts is labeled "65% recycled content; 40% from reconditioned parts." This claim is not deceptive.

Example 12:

A store sells both new and used sporting goods. One of the items for sale in the store is a baseball helmet that, although used, is no different in appearance than a brand new item. The helmet bears an unqualified "Recycled" label. This claim is deceptive because, unless evidence shows otherwise, consumers could reasonably believe that the helmet is made of recycled raw materials, when it is in fact a used item. An acceptable claim would bear a disclosure clearly stating that the helmet is used.

Example 13:

A manufacturer of home electronics labels its video cassette recorders ("VCRs") as "40% recycled." In fact, each VCR contains 40% reconditioned parts. This claim is deceptive because consumers are unlikely to know that the VCR's recycled content consists of reconditioned parts.

Example 14:

A dealer of used automotive parts recovers a serviceable engine from a vehicle that has been

totaled. Without repairing, rebuilding, remanufacturing, or in any way altering the engine or its components, the dealer attaches a "Recycled" label to the engine, and offers it for resale in its used auto parts store. In this situation, an unqualified recycled content claim is not likely to be deceptive because consumers are likely to understand that the engine is used and has not undergone any rebuilding.

Example 15:

An automobile parts dealer purchases a transmission that has been recovered from a junked vehicle. Eighty-five percent by weight of the transmission was rebuilt and 15% constitutes new materials. After rebuilding[(6)] the transmission in accordance with industry practices, the dealer packages it for resale in a box labeled "Rebuilt Transmission," or "Rebuilt Transmission (85% recycled content from rebuilt parts)," or "Recycled Transmission (85% recycled content from rebuilt parts)." These claims are not likely to be deceptive.

(f) ***Source reduction*****:** It is deceptive to misrepresent, directly or by implication, that a product or package has been reduced or is lower in weight, volume or toxicity. Source reduction claims should be qualified to the extent necessary to avoid consumer deception about the amount of the source reduction and about the basis for any comparison asserted.

Example 1:

An ad claims that solid waste created by disposal of the advertiser's packaging is "now 10% less than our previous package." The claim is not deceptive if the advertiser has substantiation that shows that disposal of the current package contributes 10% less waste by weight or volume to the solid waste stream when compared with the immediately preceding version of the package.

Example 2:

An advertiser notes that disposal of its product generates "10% less waste." The claim is ambiguous. Depending on contextual factors, it could be a comparison either to the immediately preceding product or to a competitor's product. The "10% less waste" reference is deceptive unless the seller clarifies which comparison is intended and substantiates that comparison, or substantiates both possible interpretations of the claim.

(g) ***Refillable*****:** It is deceptive to misrepresent, directly or by implication, that a package is refillable. An unqualified refillable claim should not be asserted unless a system is provided for: (1) the collection and return of the package for refill; or (2) the later refill of the package by consumers with product subsequently sold in another package. A package should not be marketed with an unqualified refillable claim, if it is up to the consumer to find new ways to refill the package.

Example 1:

A container is labeled "refillable x times." The manufacturer has the capability to refill returned containers and can show that the container will withstand being refilled at least x times. The manufacturer, however, has established no collection program. The unqualified claim is deceptive because there is no means for collection and return of the container to the manufacturer for refill.

Example 2:

A bottle of fabric softener states that it is in a "handy refillable container." The manufacturer also sells a large-sized container that indicates that the consumer is expected to use it to refill

the smaller container. The manufacturer sells the large-sized container in the same market areas where it sells the small container. The claim is not deceptive because there is a means for consumers to refill the smaller container from larger containers of the same product.

(h) ***Ozone safe and ozone friendly*****:** It is deceptive to misrepresent, directly or by implication, that a product is safe for or "friendly" to the ozone layer or the atmosphere.

For example, a claim that a product does not harm the ozone layer is deceptive if the product contains an ozone-depleting substance.

Example 1:

A product is labeled "ozone friendly." The claim is deceptive if the product contains any ozone-depleting substance, including those substances listed as Class I or Class II chemicals in Title VI of the Clean Air Act Amendments of 1990, Pub. L. No. 101-549, and others subsequently designated by EPA as ozone-depleting substances. Chemicals that have been listed or designated as Class I are chlorofluorocarbons (CFCs), halons, carbon tetrachloride, 1,1,1-trichloroethane, methyl bromide and hydrobromofluorocarbons (HBFCs). Chemicals that have been listed as Class II are hydrochlorofluorocarbons (HCFCs).

Example 2:

An aerosol air freshener is labeled "ozone friendly." Some of the product's ingredients are volatile organic compounds (VOCs) that may cause smog by contributing to ground-level ozone formation. The claim is likely to convey to consumers that the product is safe for the atmosphere as a whole, and is therefore, deceptive.

Example 3:

The seller of an aerosol product makes an unqualified claim that its product "Contains no CFCs." Although the product does not contain CFCs, it does contain HCFC-22, another ozone depleting ingredient. Because the claim "Contains no CFCs" may imply to reasonable consumers that the product does not harm the ozone layer, the claim is deceptive.

Example 4:

A product is labeled "This product is 95% less damaging to the ozone layer than past formulations that contained CFCs." The manufacturer has substituted HCFCs for CFC-12, and can substantiate that this substitution will result in 95% less ozone depletion. The qualified comparative claim is not likely to be deceptive.

§ 260.8 Environmental assessment

NATIONAL ENVIRONMENTAL POLICY ACT: In accordance with section 1.83 of the FTC's Procedures and Rules of Practice(7) and section 1501.3 of the Council on Environmental Quality's regulations for implementing the procedural provisions of National Environmental Policy Act, 42 U.S. C. 4321 et seq. (1969),(8) the Commission prepared an environmental assessment when the guides were issued in July 1992 for purposes of providing sufficient evidence and analysis to determine whether issuing the Guides for the Use of Environmental Marketing Claims required preparation of an environmental impact statement or a finding of no significant impact. After careful study, the Commission concluded that issuance of the Guides would not have a significant impact on the environment and that any such impact "would be so uncertain that environmental analysis would be

based on speculation."(9) The Commission concluded that an environmental impact statement was therefore not required. The Commission based its conclusions on the findings in the environmental assessment that issuance of the guides would have no quantifiable environmental impact because the guides are voluntary in nature, do not preempt inconsistent state laws, are based on the FTC's deception policy, and, when used in conjunction with the Commission's policy of case-by-case enforcement, are intended to aid compliance with section 5(a) of the FTC Act as that Act applies to environmental marketing claims.

The Commission has concluded that the modifications to the guides in this Notice will not have a significant effect on the environment, for the same reasons that the issuance of the original guides in 1992 and the modifications to the guides in 1996 were deemed not to have a significant effect on the environment. Therefore, the Commission concludes that an environmental impact statement is not required in conjunction with the issuance of the 1998 modifications to the Guides for the Use of Environmental Marketing Claims.

By direction of the Commission.

Donald S. Clark
Secretary

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1. *Cliffdale Associates, Inc.*, 103 F.T.C. 110, at 176, 176 n.7, n.8, Appendix, *reprinting* letter dated Oct. 14, 1983, from the Commission to The Honorable John D. Dingell, Chairman, Committee on Energy and Commerce, U.S. House of Representatives (1984) ("Deception Statement").

2. These guides do not currently address claims based on a "lifecycle" theory of environmental benefit. The Commission lacks sufficient information on which to base guidance on such claims.

3. The guides' treatment of unqualified degradable claims is intended to help prevent consumer deception and is not intended to establish performance standards for laws intended to ensure the degradability of products when littered.

4. The Mercury-Containing and Rechargeable Battery Management Act establishes uniform national labeling requirements regarding certain types of nickel-cadmium rechargeable and small lead-acid rechargeable batteries to aid in battery collection and recycling. The Battery Act requires, in general, that the batteries must be labeled with the three-chasing-arrows symbol or a comparable recycling symbol, and the statement "Battery Must Be Recycled Or Disposed Of Properly." 42 U.S.C. § 14322(b). Batteries labeled in accordance with this federal statute are deemed to be in compliance with these guides.

5. The term "used" refers to parts that are not new and that have not undergone any type of remanufacturing and/or reconditioning.

6. The term "rebuilding" means that the dealer dismantled and reconstructed the transmission as necessary, cleaned all of its internal and external parts and eliminated rust and corrosion, restored all impaired, defective or substantially worn parts to a sound condition (or replaced them if necessary), and performed any operations required to put the transmission

in sound working condition.

7. 16 CFR 1.83 (revised as of Jan. 1, 1991).

8. 40 CFR 1501.3 (1991).

9. 16 CFR 1.83(a).

Wave of Litigation Over 'Greenwashing' Poised to Break

Consumers Question Whether Labels Touting Eco Benefits Have Any Basis in Fact or Science

By Fiona Smith
Daily Journal Staff Writer

As more companies market their businesses to take advantage of growing consumer demand for earth-friendly products, legal battles are erupting over the veracity of such claims.

Buzzwords such as "sustainable," "biodegradable" and "carbon neutral" are plastered on everything from garbage bags to sweatshirts and consumers are now faced with a dizzying array of eco-labels that purport to guarantee products have met rigorous environmental standards.

The growing response from consumers is to push back against the act of exaggerating or falsely marketing products, known as "greenwashing."

"I think you're going to see a potential tidal wave of this litigation — it's just a matter of time," said Neal Marder, chair of Winston & Strawn's litigation group in Los Angeles. "You have companies trying to out out environmental, 'green' products and marketing themselves as such, and that raises the issue of potentially misleading advertising ... On behalf of my clients, I'm very concerned and I'm telling them they need to be very careful about how they go about doing business."

Among the legal battles brewing against alleged greenwashing are two proposed class action suits in the Bay Area, against Fiji bottled water and Windex glass cleaner.

In the case of Windex, manufactured by Wisconsin-based S.C. Johnson & Son, plaintiff's attorney Michael Reese claims the "Greenlist" label placed on the product is misleading and deceptive because the green certification does not come from an independent third-party, but rather the company itself. Reese said his client paid a premium for the product, and he is seeking an injunction and damages claiming unfair and deceptive business practices.

"We feel these cases are important to protect consumers," said Reese, of Reese Richman in New York. "Deceptive green marketing dilutes the meaning of what an actual green product is."

"Greenlist" is a patent-protected process developed by S.C. Johnson that ranks its product ingredients in terms of their environmental benefits with the aim of using more benign ingredients whenever possible. S.C. Johnson, and its attorney Nickolas Kacprowski with Kirkland & Ellis in San Francisco, declined to comment for the story. In court filings, the company defended its "Greenlist" label, arguing the plaintiff failed to show an actual injury and did not use common sense in interpreting the label.

Reese, representing Santa Cruz resident Wayne Koh in the suit, claims the label misled Koh into thinking the product was non-toxic and certified green.

"Hypothetically, toxic sludge, if it's in the product, it's a Greenlist ingredient," Reese said.

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San Francisco Daily Journal WEDNESDAY, FEBRUARY 10, 2010

Tidal Wave of Litigation Over Greenwashing Poised to Break, Lawyers Say

Continued from page 1

Reese has filed two proposed class actions on the issue against S.C. Johnson, one in Wisconsin, where the company is based, and another in San Jose district court, *Koh v. S.C. Johnson & Son Inc.*, 09-927. Both courts recently denied S.C. Johnson's motions to dismiss, and discovery is under way.

In a similar case, Reese is representing a San Francisco woman suing Fiji Water Co. and its holding company, Roll International Corp., on similar grounds. Reese alleges the green water drop label on Fiji bottled water tricks consumers into paying more for a product they think is environmentally superior, but in fact is not. San Francisco Superior Court Judge Richard Kramer dismissed the initial complaint for lack of stating a claim and is set to rule in March on whether to dismiss the amended complaint, *Hill v. Roll International Corp.*, CGC-09-487547.

Los Angeles-based Fiji Water Co. and its attorney Neil Popovic, with Sheppard Mullin in San Francisco, declined to comment for the story. In briefs filed by Fiji, the company denied it is deceptively marketing Fiji water and stated it follows the Federal Trade Commission's green marketing guidelines.

Those guidelines, referred to as the Green Guides, set the parameters for how companies can use certain green terms in their marketing. While the guide lays some ground rules on the how to use words such as "biodegradable" and "recyclable," it does not give exact legal definitions, nor does it have the force of law. The FTC has the discretion to go after deceptive green marketers under the Federal Trade Commission Act. Under the act, a claim is deceptive if it strays from what a reasonable person would believe the claim to mean.

The commission has brought only 22 cases related to green marketing since the Green Guides first came out in 1993. There was a spate of enforcement actions in the early years, but none during the administration of George W. Bush. In 2009, the FTC brought seven cases, including one against Kmart Corp. and others over claims that paper products were biodegradable, as well as others against several clothing sellers over claims that clothes made of rayon were instead made of eco-friendly bamboo.

At the state level, California and others have passed green marketing statutes that incorporate the parameters laid out in the FTC's Green Guides. But with California's Environmental Advertising Claims Act rarely, if ever, invoked, and with few investigations at the federal level in recent years, it's creating perfect conditions for greenwashing to grow unchecked, said Brooks Beard, a partner at Morrison & Foerster in San Francisco.

The FTC is currently revising its Green Guides to address the proliferation of green marketing in recent years and will release new guidelines in the "not too distant future," said James Kohm, associate director of the enforcement division with the FTC.

Green marketing claims pose a real challenge because it's impossible to tell from looking at a greeting card, for example, whether it's really made from recycled paper, Kohm said.

"[Consumers] don't have a good way of finding out if that's true, and it's particularly important in those claims to have someone policing them," Kohm said.

In the new Green Guides, the FTC has signaled it may for the first time craft guidance over the marketing of carbon offsets and the use of words such as "sustainable" and "renewable."

The FTC has to be careful to balance the need to have a specific enough definition of such words to avoid loopholes, but make it general enough so it doesn't tie businesses' hands, said Sylvia Burks, a partner with Pillsbury Winthrop Shaw Pittman in Palo Alto.

Burks, who advises clients on this issue, including a startup that makes biodegradable dinnerware, said the issue of green claims will only grow more important if federal climate change legislation creates even more economic incentives and requirements to go green.

"I get frustrated as a lawyer, looking at packaging, when people are saying they're 'more renewable.' What does it mean and what's the science to back this up?" Burks said. "Everyone's just getting on the bandwagon."

Even the timber industry is trying to get a piece of the action, leading to a recent dispute over the integrity of two eco-labels, both of which are vying for market share to meet the growing demand for environmentally certified wood.

San Francisco and Canada-based nonprofit ForestEthics filed a complaint in September of 2009 with the FTC against eco-label Sustainable Forestry Initiative, alleging it is controlled by the timber industry and its process has lax standards that deceive consumers into thinking its certified timber is environmentally sound.

"We're talking about billions of dollars in discretionary consumer spending in green products," said Peter Goldman, director and managing attorney at the Washington Forest Law Center, who is representing ForestEthics in the complaint. "There's a whole green world coming where consumer and businesses purchasers of paper products are going to insist on green certification."

The FTC's Kohm declined to comment.

In reaction to the complaint, a group of timber companies and landowners — many of whom have received their certification through Sustainable Forestry Initiative — formed the Coalition for Fair Forest Certification. The coalition in turn filed a complaint with the FTC against Sustainable's rival, the Forest Stewardship Council, claiming that its certification process lacks uniform standards and, as a result, hurts domestic timber producers and amounts to deceptive marketing, according to the group's attorney, Thomas Collier, a partner with Steptoe & Johnson in Washington, D.C.

The coalition's complaint also accuses the U.S. Green Building Council, a nonprofit that certifies green buildings, of illegally discriminating against the Sustainable Forestry Initiative by only accepting FSC-certified wood into its popular LEED green building standard.

"My clients are very concerned over what they feel are discriminatory practices against timber grown in the U.S.," Collier said. "Timber being grown in the U.S. is being pushed out of the market and being pushed out of the green market."

fiona_smith@dailyjournal.com

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Judge Throws Out Lawsuit Against Fiji Water

By Fiona Smith
Daily Journal Staff Writer

A San Francisco Superior Court judge has thrown out a potential class action suit against Fiji Water Co. alleging that it falsely marketed its bottled water as being environmentally friendly.

The case was one of the first of its kind to take aim at the growing number of companies that tout their products — sometimes inaccurately — as "green."

Attorneys for plaintiff and San Francisco resident Ayana Hill claimed Fiji Water had violated California's unfair competition and environmental marketing laws by placing a green water drop on the front of its bottle and referring to itself as Fiji Green. That advertising misled consumers into thinking the water was environmentally superior to other bottled water brands, when in fact it isn't, argued Hill's attorney Michael Reese, of Reese Richman in New York.

Judge Richard Kramer rejected those arguments in a hearing Friday, granted Fiji Water Co.'s demurrer and dismissed the case, *Hill v. Roll International Corp.*, CGC-09-487547.

He characterized the plaintiffs' "green movement" as ill-defined and said they failed to show there is a clear legal marketing standard that the color green or the green water drop symbol must comply with.

The plaintiff's claims are "far too imprecise to be the basis for liability of the nature alleged in the complaint," Kramer said. "There's no way that any disseminator of products could know in advance whether its products would meet the requirements of this movement."

In response, Reese argued that Fiji Water violated the standards set out by the Federal Trade Commission's green marketing guidelines that were adopted into California law through the state's environmental marketing claims act.

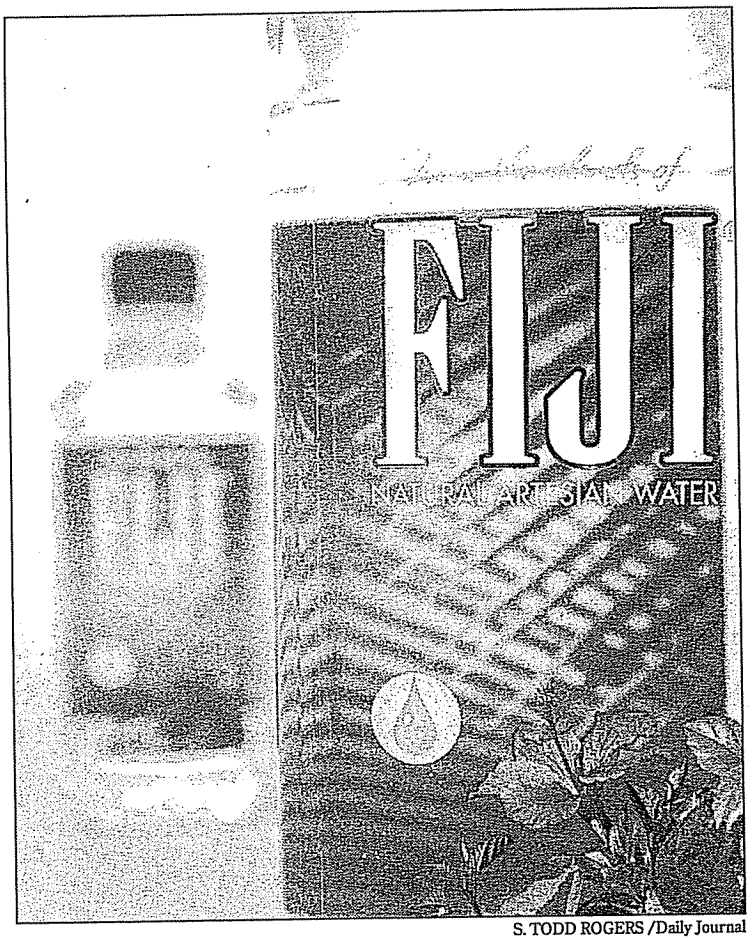
Kramer said Reese was reading words into the law that weren't there, suggesting that under this interpretation, Irish-themed products colored green could be found to mislead consumers as to their environmental integrity.

"You can't have a body of law that doesn't have some standards ... It doesn't subsume everything that's colored green, whether it's a drop or an outboard canoe," Kramer said.

Fiji Water's attorney Daniel Beck said the plaintiffs would like to take the word "green" out of circulation and are substituting unsubstantiated claims about Fiji's environmental practices for clear legal standards.

"There's nothing in the FTC guidelines or California or federal law that the word 'green' should belong to this specific set of environmental requirements," said Beck, with the Roll Law Group in Los Angeles. "It puts companies...at the mercy of this extremely vague standard."

Reese said he would appeal the decision. "We obviously disagree," he said of the judge's ruling. "We feel there are precise standards laid out by the FTC and obviously the use of green wording and images on a product like this aren't meaningless."



S. TODD ROGERS /Daily Journal

A lawsuit claimed Fiji water was falsely marketed as being environmentally friendly.

His firm is pursuing other cases of alleged greenwashing: a similar case pending against Fiji Water in New York's eastern district court, *Harpaz v. Roll International Corp.*, 10-302, and two cases in federal court against S.C. Johnson & Son Inc. over labeling of its Windex cleaner, *Koh v. S.C. Johnson & Son Inc.*, 09-927 (N.D. Calif.) and *Petlack v. S.C. Johnson & Son Inc.*, 08-820, (E.D. Wisc.).

fiona_smith@dailyjournal.com

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