B Resource Guide:

Conducting a Life Cycle Assessment (LCA)

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What's in this Guide:

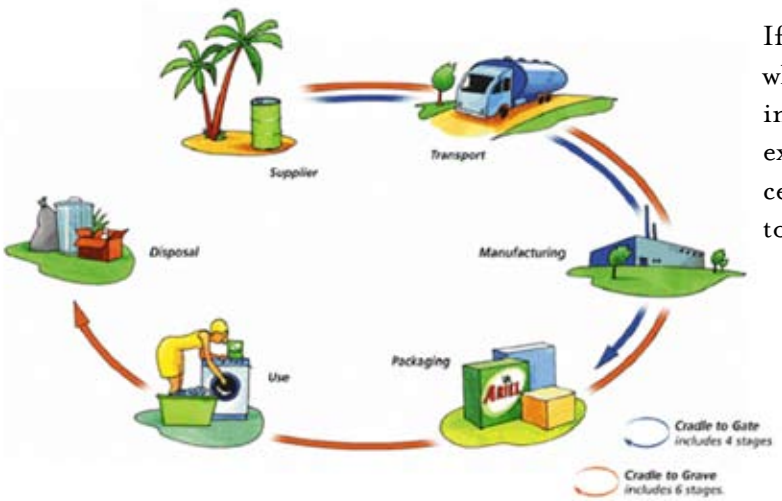
I. Definition: What is a Life Cycle Assessment (LCA)?

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 nd releases;
- interpreting the results to help make a more informed decision about the human health and environmental impacts of products, processes, and activities.[1]

Life Cycle Assessments have been done on a huge variety of products and processes, including jet engines, diapers, drinking cups, computers, remediation techniques, and trash disposal.

For a typical product, LCA takes into account the supply of raw materials needed to produce the product, the manufacturing of intermediates and finally the product itself, including packaging, transportation of raw materials, intermediates and the product, use of the product and disposal of the product after use. [2] This sequence, as depicted below, is called "Cradle to Grave" assessment.



If you have a product that generates no waste, i.e., where all materials are recyclable or can be turned into biologically safe nutrients, you could also explore "Cradle to Cradle" standards for certification (see our B Resource Guide on Cradle to Cradle Design).

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There are four main phases of the LCA process:

1. Goals and Scoping[3]

The scoping step determines which processes will be included, which environmental concerns will be included, what economic or social good is provided by the goods or services in question, resolves any technical issues and defines the audience for the LCA.

2. Life Cycle Inventory (LCI)

The inventory provides information about all environmental inputs and outputs from all parts of the product system involved in the life cycle assessment. This involves modeling of the product system, data collection and verification of data for inputs and outputs for all parts of the product system. Inputs include: inputs of materials, energy, chemicals and 'other'. Outputs include: air emissions, water emissions and solid waste.

3. Life Cycle Impact Assessment[4]

The assessment takes inventory data and converts it to indicators for each impact category. A typical list of impact indicators includes:

- Global Climate Change
- Stratospheric Ozone Depletion
- Smog
- Acidification
- Eutrophication
- Natural Resources (habitat, water, fossil fuels, minerals, biological resources)
- Human Toxicity
- Ecotoxicity

4. Interpretation

The last step is an analysis of the impact data, which leads to the conclusion whether the ambitions from the goal and scope can be met.

II. Why Conduct a Life Cycle Assessment?

There are many reasons for your company to conduct a Life Cycle Assessment. It can be used to reduce environmental impact and waste, reduce costs, focus product development, support marketing claims, improve product/corporate image and/or identify appropriate performance indicators. Further, doing an LCA creates common metrics that can be compared and shared across your company, or with your suppliers and partners.

III. Examples of Life Cycle Assessments

- Asian Institute of Technology's Example of LCA for a Whiteboard Marker

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http://www.howproductsimpact.net/

• Life Cycle Assessment of Paperboard Packaging in Thailand
http://www.howproductsimpact.net/box/
• Proctor & Gamble's Case Studies
http://www.scienceinthebox.com/en_UK/sustainability/casestudies_en.html
• Stonyfield Farm - Packaging Choices Matter
http://www.stonyfield.com/EarthActions/Environmental%20Practices/EnvironmentalPackaging.cfm

Stonyfield Farm has published one of the most compelling public reports we've found on LCAs. Highlights are below.

Case Study: The Life of Stonyfield Farm Packaging[5]
LCA has taught us not only to look at a product from "cradle to grave", but to look at a bigger picture as well. Previously, we had examined environmental attributes of our yogurt cup and lid. Every time a cup of yogurt is sold, a plastic cup and lid is created (primary packaging), as well as the box and plastic wrap to hold and transport the cup (secondary packaging). By looking at the cup alone and the environmental impact of the primary packaging, LCA has demonstrated that one could miss the potentially greater environmental burden from the secondary packaging.

For instance, consider if we packaged our product in highly recyclable cups in a heavy box that used toxic inks and solvent adhesives to seal it. If we examined only the primary packaging, then we would conclude that it was good packaging because it is recyclable. In fact, the total "product delivery system" (PDS) could have significantly greater environmental impact than if the cup were made from a nonrecyclable, stronger material, which would allow for a lighter weight box. LCA has taught us that we must examine the entire PDS to see the whole picture and the total environmental burden of getting a cup of yogurt to the store shelves. The resources used to deliver product to our customers extend far deeper than most would assume when picking a cup of maple vanilla yogurt off the shelf at the grocery store.

The Center for Sustainable Systems Study. In the fall of 1999, Stonyfield Farm commissioned a study by the University of Michigan's Center for Sustainable Systems to perform a life cycle assessment of Stonyfield Farm's "product delivery system" (PDS). The PDS is the sum of the materials and distribution involved in getting Stonyfield Farm's products to market. It consists of primary packaging (yogurt containers, lids, inner seals, multipack wraps), secondary packaging (corrugated boxes, stretch warp, pallets, etc.) all transportation links required to deliver the materials, packaging and yogurt products from the initial material production, through to you, the consumer, and end-of-life disposal. The objective of the study was to perform a life cycle assessment of Stonyfield Farm's current PDS, and to compare it to other options with different cups including HDPE (#2), coated unbleached paperboard, thermoformed plastic, and polylactide (PLA), a carbohydrate based polymer made from corn and/or beets.

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Key Findings of The Study. One of the key findings showed that the choice of container size has a greater impact on environmental burdens than either the choice of cup material or the cup manufacturing process. The 32 oz. containers (quarts) consumed 27% less energy to produce and distribute than the 8 oz. containers. If all Stonyfield Farm yogurt were sold in 32 oz. containers, the annualized energy savings would be equivalent to 11,250 barrels of oil. Your purchasing decisions make a difference!

Other key recommendations for reducing environmental burdens included switching to thermoformed cup manufacturing, minimizing the distance traveled from Stonyfield Farm to retailers by opening a second yogurt production facility, optimizing the ratio of primary packaging to corrugated board, as well as further investigating renewable packaging materials. For a more detailed examination of the results of the study, read the entire study at the Center for Sustainable Systems' website.

IV. Conducting Your Own LCA

Life Cycle Assessments are regulated by the International Standardization Organization ISO 14000 (http://www.iso-14001.org.uk/index.htm) - a series of voluntary standards and guideline reference documents.

The following publications and software packages provide step-by-step instructions on how to conduct a life cycle assessment.

Publications

• *LCA: How to Do It*
The United Nations Environment Program (UNEP)
http://www.uneptie.org/pc/pc/tools/lca.htm
http://lcinitiative.unep.fr/default.asp?site=lcinit&page_id=F511DC47-8407-41E9-AB5D-64934130 88FB%2%20
Instructions start on page 15.

• *Life Cycle for Mere Mortals*
Rita Schenck, Institute for Research and Environmental Education
http://www.iere.org/mortals.html
This book is written for the person who has never participated in the performance of an LCA but is confronted by the need to get one done, either as the lead on the project or in a supporting role. It give background on the history of LCA, the ISO standards for performing an LCA and many hints on how to manage both one's own role and the efforts of others, including outside stakeholders.

There are also a number of software programs that you can use to complete lifecycle assessments.

LCA Software Programs

- SimaPro7

http://www.pre.nl/simapro/default.htm
SimaPro is the most widely used life cycle assessment (LCA) software, employed by nearly a thousand users ranging from major industries and consultants, to research institutes and universities. The new SimaPro 7 provides a tool to collect, analyze and monitor the environmental performance of products and services.

• GaBi Software
http://www.gabi-software.com/
This software helps model environmental, economic and social impacts of complex anthropogenic systems. It allows you to collect life cycle inventories data and arrange it for all life cycle phases.

V. Outsourcing your LCA

Completing a Life Cycle Assessment in-house may require more technical expertise or time commitment than your business can provide. In this instance, you may decide to hire a consulting company to assist you with conducting a life cycle assessment. Below are some industry leaders:

Cost
Outsourcing your LCA could cost anywhere from $10,000 to $60,000 depending on the nature of the assessment, how much existing information is available for use and how many alternatives a company is looking to review. For example a straightforward comparison of two different types of packaging might cost about $10,000 to complete while a more detailed, multi-process LCA would run closer to $60,000.

• Franklin Associates
www.fal.com/lifecycle.htm
Franklin Associates provides life cycle services that track and identify the true costs and environmental impacts of products or processes, revealing areas where improvements and cost reductions are needed to maximize company profits and minimize environmental burdens.

• Product Ecology (PRé) Consultants
http://www.pre.nl/consultancy.htm
PRé Consultants has experience in conducting the full range of LCAs from large ISO compatible studies to screenings that take less than a week. They are the creator of SimaPro7 LCA software.

Pre Consultants US Partner: Earth Shift
http://www.earthshift.com/
Earth Shift provides Environmental Business Assessment, Life Cycle Assessment, and Total Cost Assessment consulting services with focuses on manufacturing and building construction.

• Pira Consulting

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http://www.piraconsulting.com/pc/sus/sus_lcm.php
Pira International serves the paper, packaging, print and publishing supply chain. Services provided ranged from packaging selection to achieve maximum market impact to advising paper mills and printing plants on compliance with relevant environmental legislation. Pira's expertise covers the entire value chain from sourcing the original raw materials to the point of retail sale to the eventual end user. Pira Consulting conducts LCA studies, LCA data review, audits of completed LCAs, and LCA training, support and advice.

VI. Helpful Websites

- American Center for Life Cycle Assessment - http://www.lcacenter.org/
- EPA Design for the Environment - http://www.epa.gov/oppt/dfe/index.htm
- Cradle to Grave: How products impact Natural Systems - http://www.howproductsimpact.net/

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[1] http://www.epa.gov/nrmrl/lcaccess/index.html
[2] http://www.scienceinthebox.com/en_UK/sustainability/lifecycleassessment_en.html
[3] http://www.lcacenter.org/LCA/LCA-yardstick.html
[4] http://www.lcacenter.org/LCA/LCA-yardstick.html
[5] http://www.stonyfield.com/EarthActions/Environmental%20Practices/EnvironmentalPackaging.cfm