

Mapping the Environmental Consequence of Design Decisions: Introduction

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Overview

- Goal
 - Examine the need for an environmental evaluation method
 - Provide an overview of Life Cycle Assessment

What are some examples of products that compete on environmental characteristics?

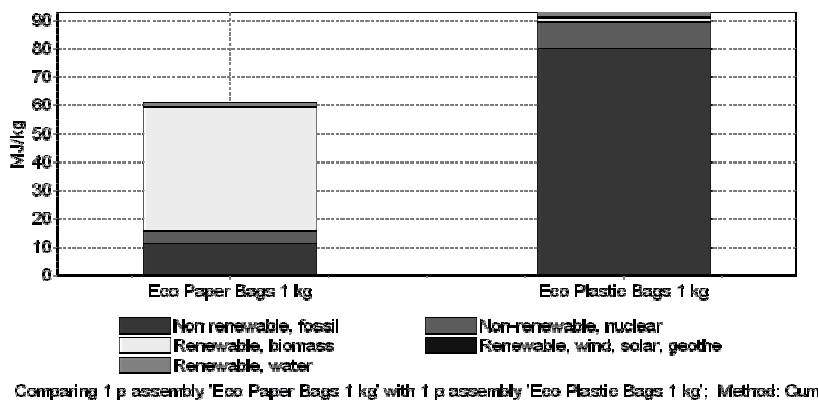
How would you make an engineering decision to evaluate options?

Example: Comparing Grocery Sacks

- Your firm is going to launch a new line of grocery stores that focuses on environmentally and socially conscious consumers
 - Stop &  Care & Shop
- Your task has been to identify the type of grocery sacks you will offer
 - Paper or plastic?

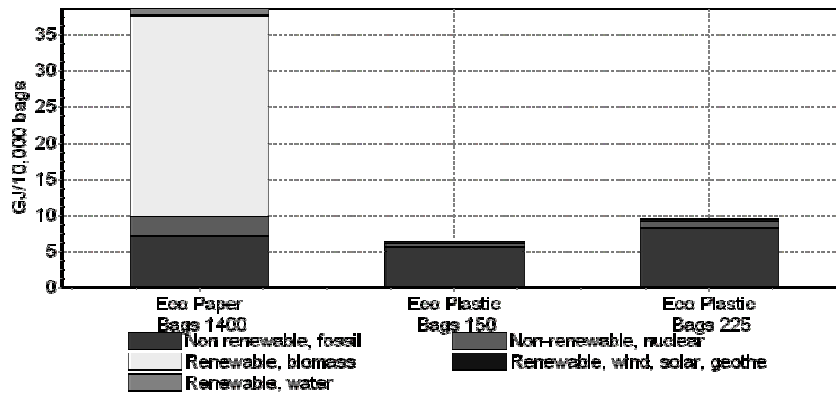
- What do you need to know?

Comparing Paper and Plastic: Comparing Unit Production Energy



What about product design?

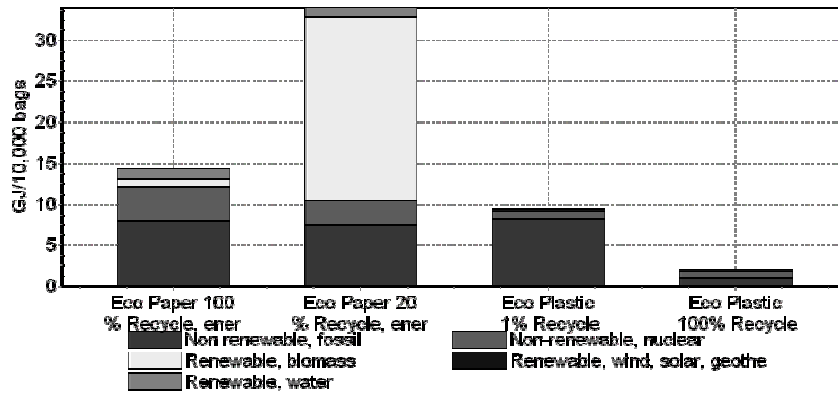
Comparing Paper and Plastic: Production Energy of a Single Bag



Comparing 1 p assembly 'Eco Paper Bags 1400 lb' with 1 p assembly 'Eco Plastic Bags 150 lb' and with

What happens to the bag after production?

Comparing Paper and Plastic: Comparing Unit Production Energy with Recovery



Comparing product stages; Method: Cumulative Energy Demand V1.03 / Cumulative energy demand / sl

Materials Substitution: Making Better Materials Choices

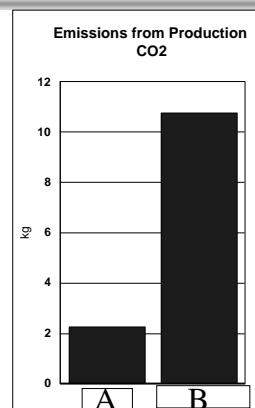
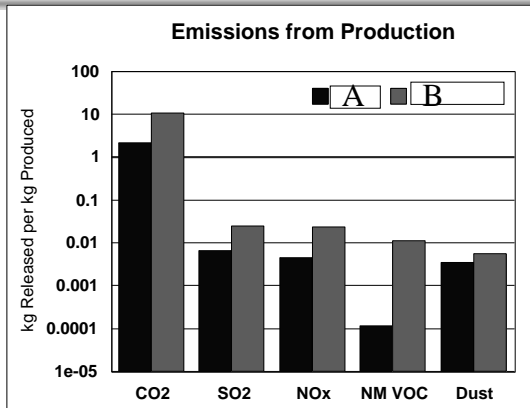
Which Material would you Choose?

Material A
 CO2 2 kg / kg
 SO2 0.008
 NOx 0.007



Material B
 CO2 11 kg / kg
 SO2 0.4
 NOx 0.3

Which would you choose?



Why does B advertise itself as Environmental?

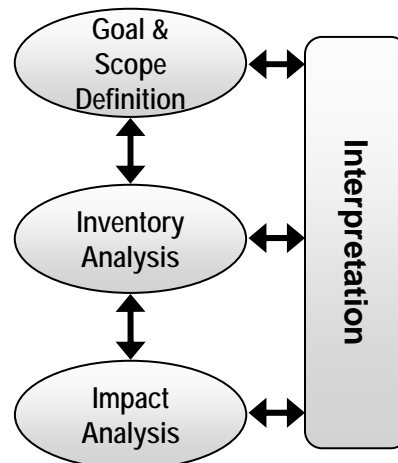
What is Life-cycle Assessment?

- SETAC Definition:

“The life cycle assessment is an objective process to evaluate the environmental burdens associated with a product, process, or activity by identifying and quantifying energy and materials usage and environmental releases, to assess the impact of those... and to evaluate and implement opportunities to effect environmental improvements...”

LCA: Methodology

- Goal & Scope Definition
 - What is the unit of analysis?
 - What materials, processes, or products are to be considered?
- Inventory Analysis
 - Identify & quantify
 - Energy inflows
 - Material inflows
 - Releases
- Impact Analysis
 - Relating inventory to impact on world



Establishing Common LCA Practice

- **SETAC**
(Society of Environmental Toxicology and Chemistry)
 - Regarded as pioneering organization establishing LCA procedures
- **ISO 14040 (1997) - 14043 (2000)**
 - Defines LCA as:
“compilation and evaluation of the inputs, outputs, and potential environmental impacts of a product system throughout its life-cycle”

Why Carry Out a Life-Cycle Assessment? Goals

- **Decision-making**
 - Product design
 - Process design
 - Purchasing
 - Policy-making
- **Communication**
 - Eco-labeling
 - Product declarations
 - Benchmarking
- **Learning / exploration**
 - Identifying improvement opportunities
 - Identify liability concerns
 - Selecting performance indicators
 - Research

Why Carry Out a Life-Cycle Assessment? Advantages

- **Systems perspective**
 - Many impacts occur because of decisions we control, but not directly due to our actions
 - Avoids media shifting
- **Product / activity focus**
 - Allows consideration of alternative paths to fulfilling objective
- **Analytical**
 - Provides orderly structure to evaluation
 - Not value-free

LCA Limitations

- **Holistic point of view is a strength and weakness**
 - Tends to simplify to achieve scope
- **Does not fully capture localized effects**
- **Tends to be static analysis**
- **Tends to be linear analysis**
- **Ignores other impacts**
 - Economic
 - Social
- **Data availability**
- **Analytic intensity**

What are the key issues to consider?

Key Issues to Consider

- Functional Unit
 - What is compared to what?
 - Aluminum cans
 - Laundry Detergent
- System boundaries
 - What will be included?
- Allocation
 - What about other useful outflows?
- Type of data
 - Local specifics vs. Averages
- Impact assessment method

Resources

- Text:
 - "The Hitch Hiker's Guide to LCA" Baumann and Tillman
 - On reserve in the library
 - \$39 on Amazon
- Readings on MIT server
 - "LCA: What is it?" & "LCA: How to do it?", UNEP
 - "Intro to LCA with SimaPro", Pre Consulting
- Readings
 - Today - Chapter 1
 - Thurs (3/9) - "Intro with Simapro"
 - 3/14 - Ch 3
 - Goal & Scope Assignment
 - 3/16 - No class
 - 3/21, 3/23, & 4/4 - Ch 4
 - 4/6 - Case 1 Presentations
 - 4/13 & 4/20 - Ch 5



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Assignment #4: Considering LCA Goal & Scope

- Select a product or activity
- Characterize two distinct goals for carrying out an LCA
 - Both goals should represent distinct stakeholder perspectives
 - Producer, consumer, regulator, NGO ...



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Assignment #4: G&S Characterization

- Describe activity
- Identify stakeholder and motivations of stakeholder
- What alternatives are being compared?
- What is functional unit?
- What are geographical system boundaries?
 - Should export be considered?
 - Activities outside of US?
- What is the time horizon of the study?
- What are the conceptual boundaries of the study?
 - What activities are included?
 - What about capital goods?

Case 1 - LCA of a Product - (April 4)

- Select a set of product or activity on which to perform a comparative LCA
- Presentation:
 - What is product?
 - Overview of environmental concerns raised publicly
 - Goal & scope
 - Goal
 - What alternatives are being considered?
 - Boundaries
 - Inventory
 - How is product made?
 - Major assumptions
 - Data sources
 - Impact assessment
 - Recommendations
- Writeup - 3-5 page writeup of case and recommendations