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# **Life Cycle (LCA) Thinking for Packaging Materials in Product Improvement Process**

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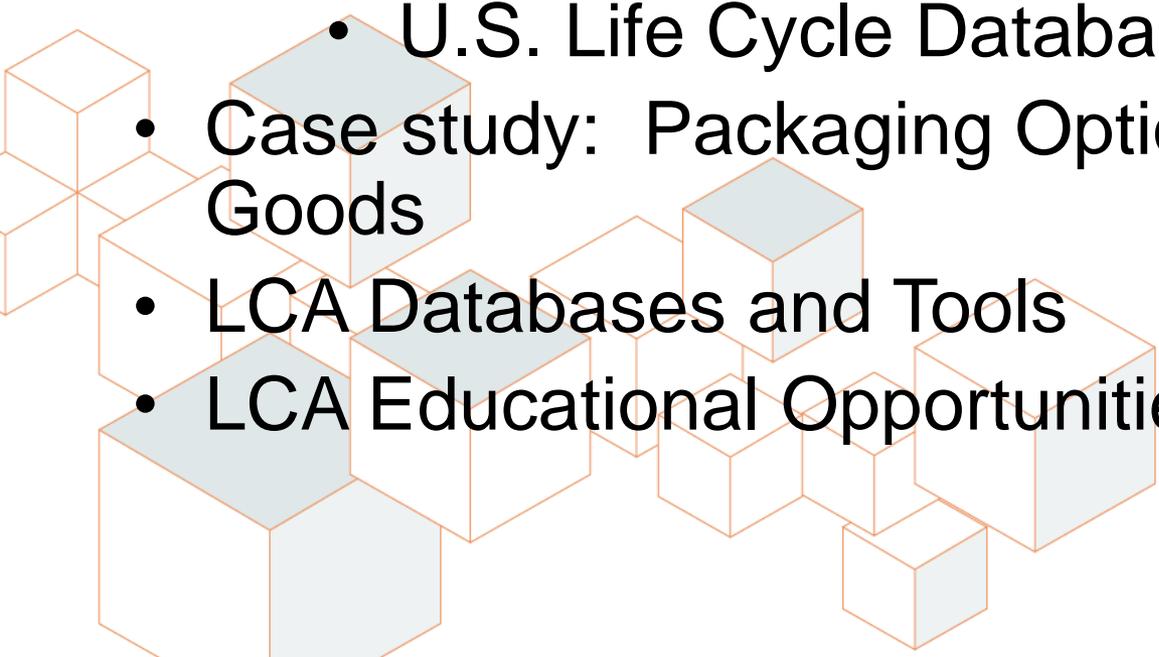
Mike Levy, ACC  
September 15, 2011



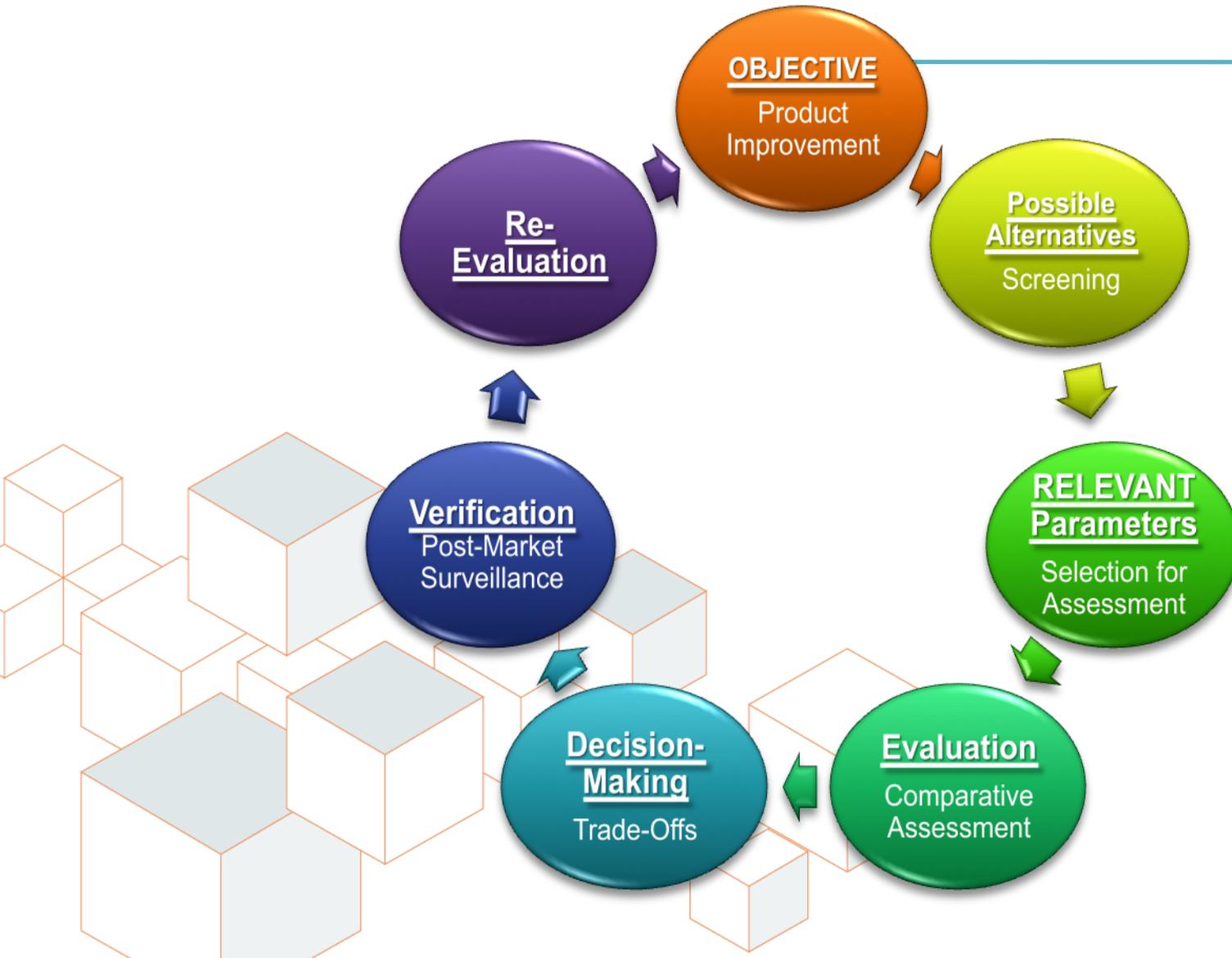
# Presentation Topics

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- Overview
- LCA thinking: a good fit for alternatives analysis
  - LCAs, LCI and ISO Standards
  - LCA data sources
    - Why ACC developed LCI data
    - U.S. Life Cycle Database
- Case study: Packaging Options for Shipping Soft Goods
- LCA Databases and Tools
- LCA Educational Opportunities



# Continuous Improvement



# Multi-factorial Evaluation Matrix CA Statutory A-M

## Criteria covered by a life cycle approach (in blue)

Companies consider ALL of these factors within the Product R&D process

### (i) Safety (human and environmental)

(K)-Public Health Impacts, incl. sensitive subpopulations

(L)-Environmental Impacts

(E)-Water quality impacts

(F)-Air emissions

(I)-GHG emissions

(J)-Waste/End-of-Life Disposal

-Toxicological endpoints

-Physicochemical properties

### (ii) Performance and Value

(A)-Product function/performance (to include compatibility)

(B)-Useful Life

(M)-Economic impact

-Consumer Acceptance

### (iii) Lifecycle/Resource utilization

(C)-Material/Resource Consumption

(D)-Water conservation

(G)-Energy inputs (Production, In-use, and transportation)

(H)-Energy efficiency

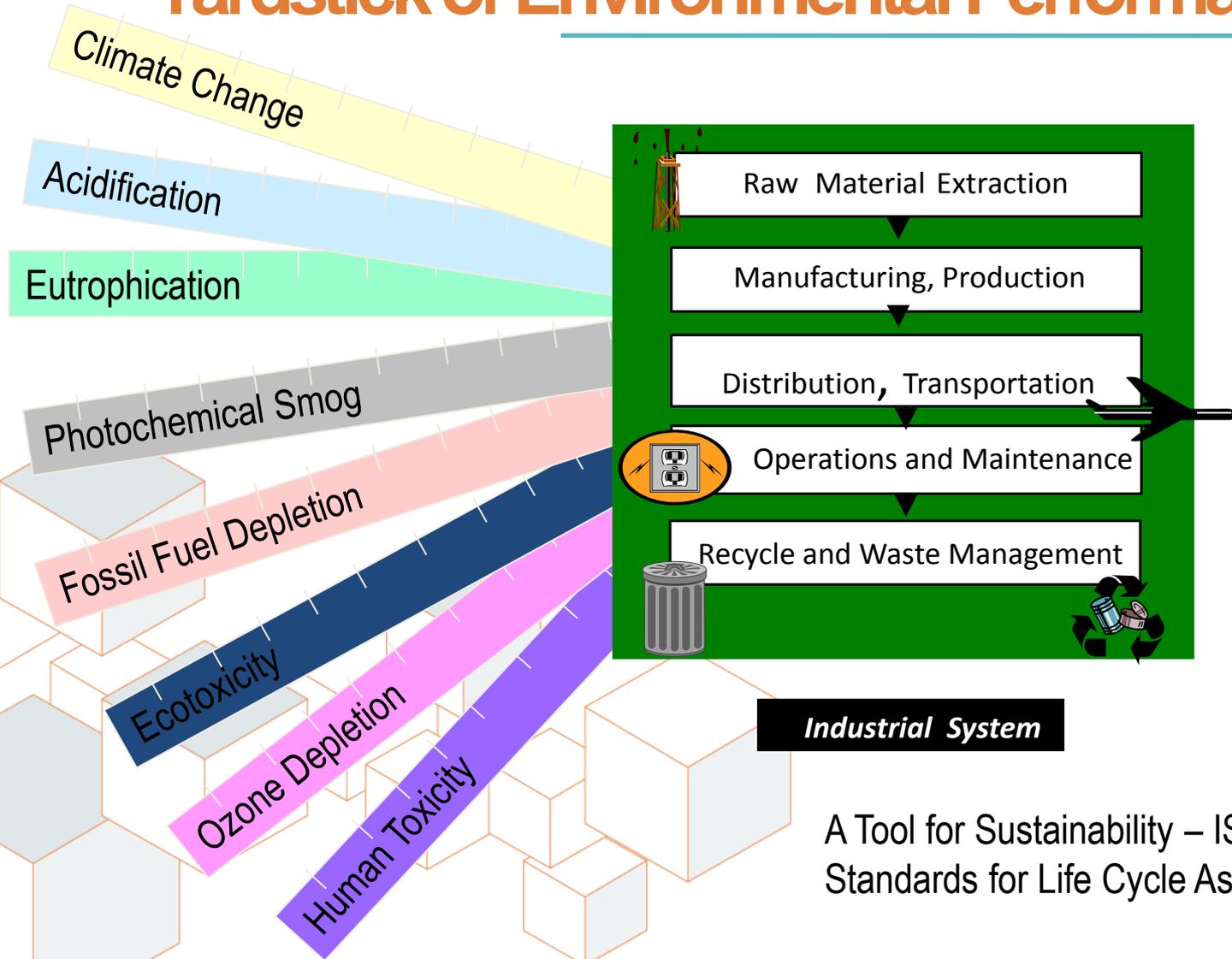
### (iv) Other

-Availability/sourcing

-Manufacturing capability

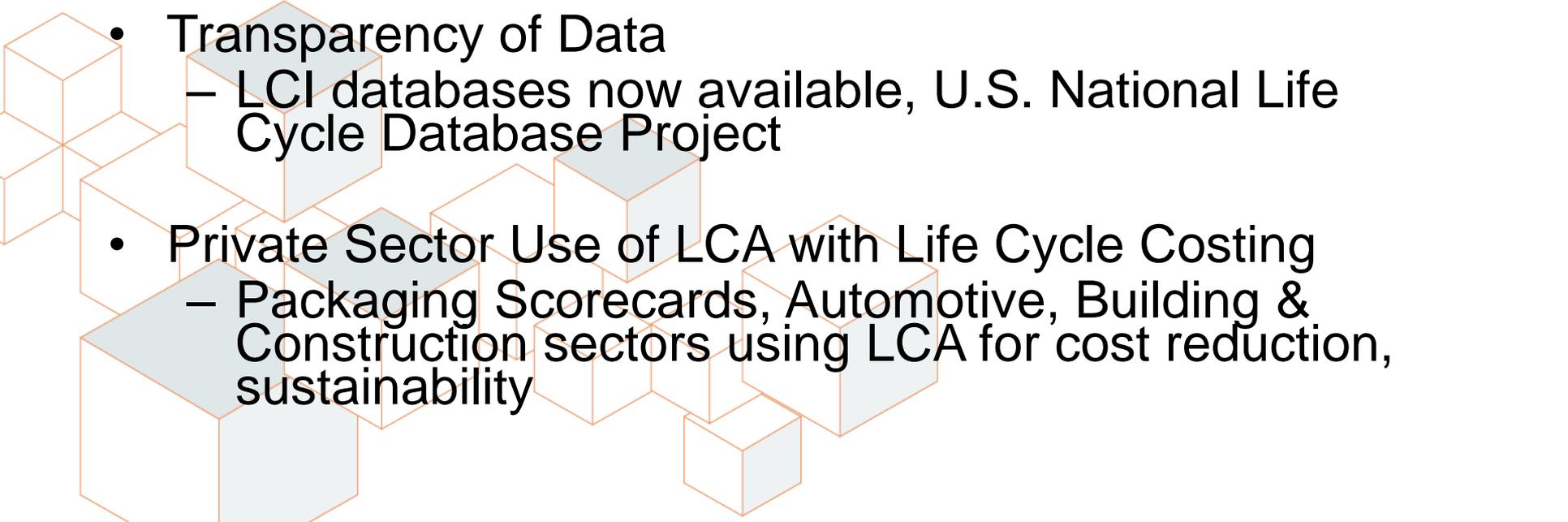
-Regulatory compliance

# Life Cycle Assessment: The Holistic Yardstick of Environmental Performance



A Tool for Sustainability – ISO 14044  
Standards for Life Cycle Assessment

# Why a Resurgence for Life Cycle?

- Government Regulations
    - EPA's EPP program for procurement
    - USDA's Biobased Product Preference Guidelines (BEES program under NIST/LCA)
  - Standardization of Life Cycle Methodology
    - International standards for LCA - ISO 14044
  - Transparency of Data
    - LCI databases now available, U.S. National Life Cycle Database Project
  - Private Sector Use of LCA with Life Cycle Costing
    - Packaging Scorecards, Automotive, Building & Construction sectors using LCA for cost reduction, sustainability
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# U.S. Life Cycle Database - Where Is It?

## www.nrel.gov/lci

The screenshot shows a Mozilla Firefox browser window displaying the NREL U.S. Life-Cycle Inventory Database homepage. The browser's address bar shows the URL <http://www.nrel.gov/lci/>. The page features the NREL logo and the tagline "Innovation for Our Energy Future". A navigation menu includes links for "About NREL", "NREL's R&D", "Applying Technologies", "Learning About Renewables", and "NREL Home". The main heading is "U.S. Life-Cycle Inventory Database". A search bar on the right offers "More Search Options" and a "Search" button, along with a "Site Map" link. A sidebar on the left lists sections: "About the Project", "Database", "Publications", "Life-Cycle Assessments", and "Related Links". The main content area includes a large image of a green field and a description of the LCI Database, stating it helps life-cycle assessment (LCA) experts answer questions about environmental impact. It also mentions that the LCI data are consistent with international standards and provides a link to a "Printable Version". At the bottom, a banner states "This Web Site is Powered by Renewable Energy" and provides information about NREL's affiliation with the U.S. Department of Energy and the Midwest Research Institute • Battelle. Footer links include "Need Help?", "Security & Privacy", "Disclaimer", and "NREL Home".

NREL: U.S. Life-Cycle Inventory Database Home Page - Mozilla Firefox

File Edit View Go Bookmarks Tools Help

http://www.nrel.gov/lci/

**NREL** National Renewable Energy Laboratory *Innovation for Our Energy Future*

About NREL **NREL's R&D** Applying Technologies Learning About Renewables NREL Home

## U.S. Life-Cycle Inventory Database

More Search Options Search  
Site Map

**About the Project**  
**Database**  
**Publications**  
**Life-Cycle Assessments**  
**Related Links**

NREL's Buildings research supports the U.S. Department of Energy's [Building Technologies Program](#).

NREL and its partners created the U.S. Life-Cycle Inventory (LCI) Database to help life-cycle assessment (LCA) experts answer their questions about environmental impact. This [database](#) provides a cradle-to-grave accounting of the energy and material flows into and out of the environment that are associated with producing a material, component, or assembly. It's an online storeroom of data collected on commonly used materials, products, and processes.

The critically reviewed LCI data are consistent with a common research protocol and with international standards. The LCI data support efforts to develop product LCAs, support systems, and LCA tools.

[Printable Version](#)

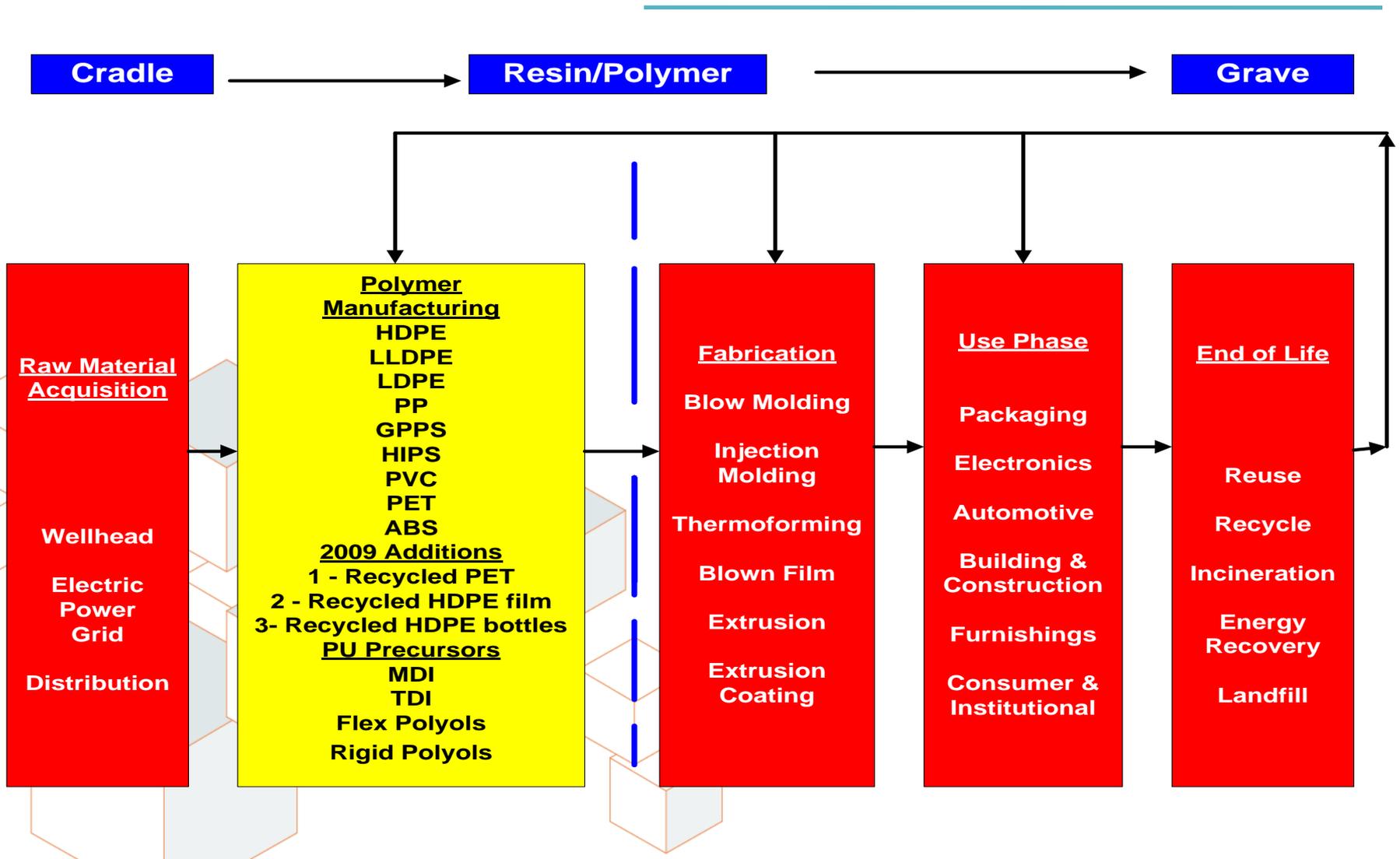
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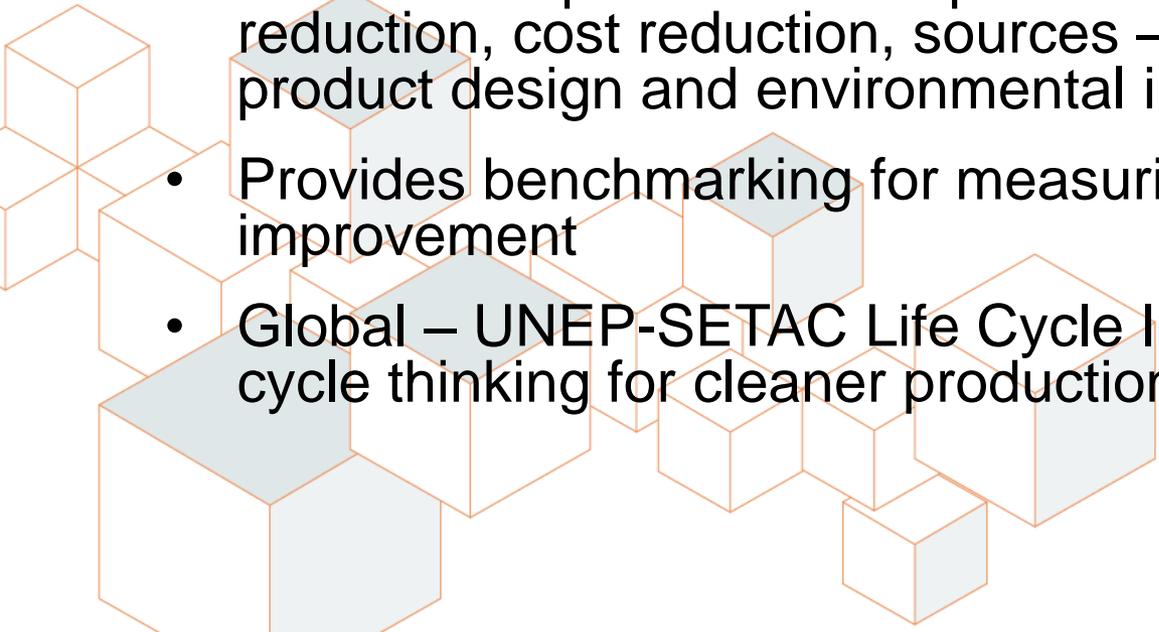
# 2010 Update: ACC Plastics Polymer & Polyurethanes LCI Database



# Why Life Cycle Thinking for Alternatives Assessment?

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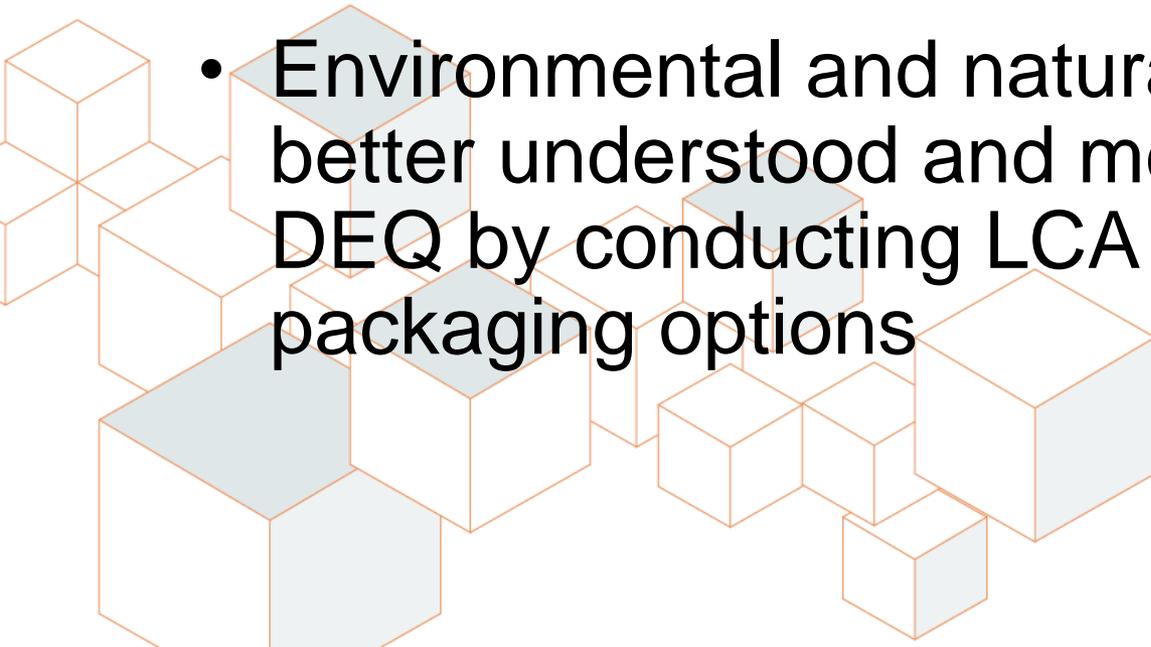
- Provides multi-parameter look at all environmental, safety, health and impacts of a product system – cradle to grave
- Provides mechanism to identify product improvement – a “what if” analysis to maximize energy/emissions reduction and ability to lower overall footprint
- Incentivizes product development criteria like source reduction, cost reduction, sources – for more sustainable product design and environmental improvement
- Provides benchmarking for measuring continued improvement
- Global – UNEP-SETAC Life Cycle Initiative utilizes life cycle thinking for cleaner production technologies



# Case Study: Oregon DEQ's Life Cycle Inventory of Packaging Options

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- Those who ship non-breakable items via common carrier have many different packaging options
- Environmental and natural resource issues better understood and measured by OR DEQ by conducting LCA of 26 different packaging options



# Case Study:

## Why LCA – because environmental challenges are complex

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- Changing packaging to reduce solid waste may have unintended consequences elsewhere, like an increase in energy use, greenhouse gases or water pollution

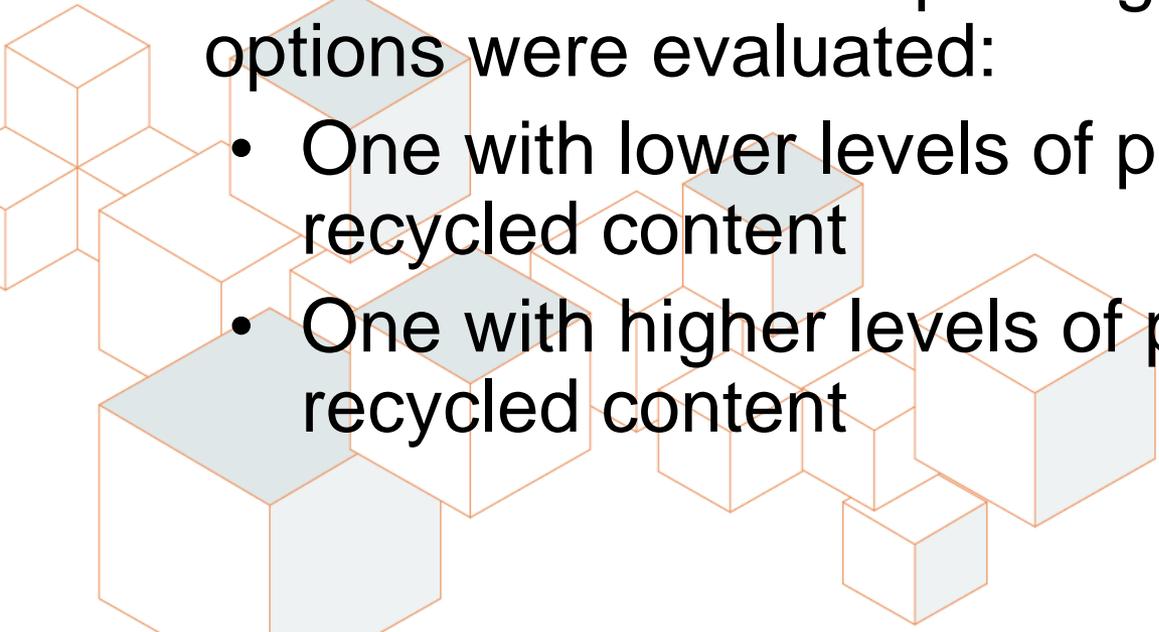
- LCA helps understand trade-offs and identify where in product life cycle greatest environmental burden occurs

- <http://www.deq.state.or.us/wmc/solwaste/data/LifeCycleReport.htm>

# 26 Packaging Options

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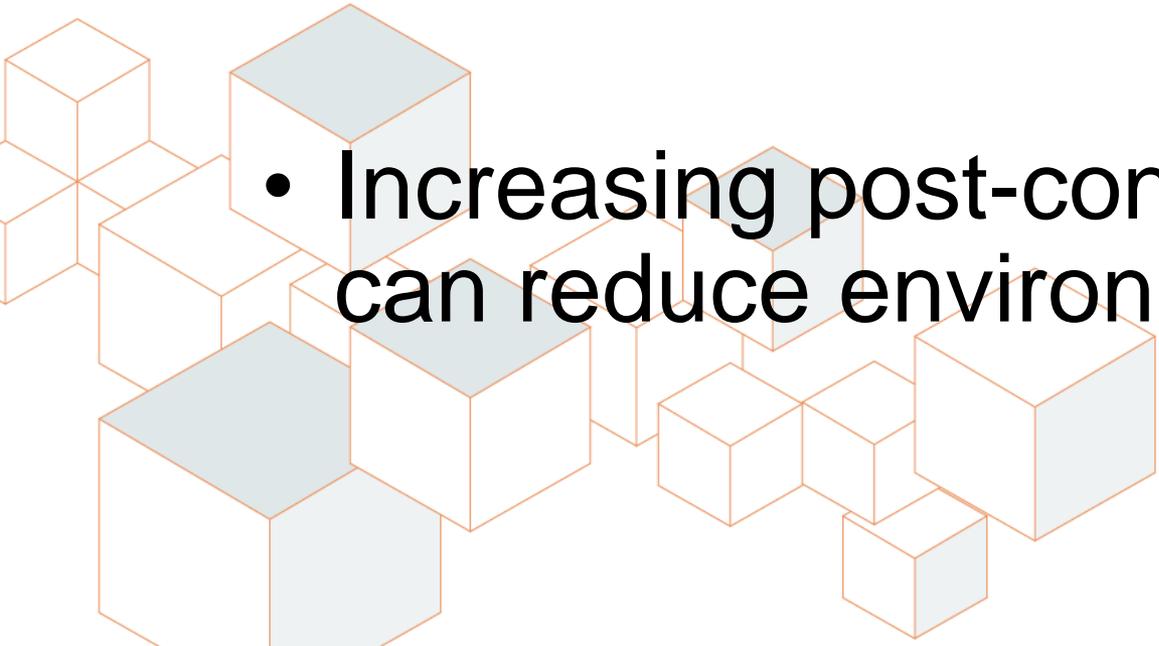
- 5 different kinds of shipping bags
- Corrugated box with 8 different types of void fills
- For each of these 13 packaging systems, two options were evaluated:
  - One with lower levels of post-consumer recycled content
  - One with higher levels of post-consumer recycled content



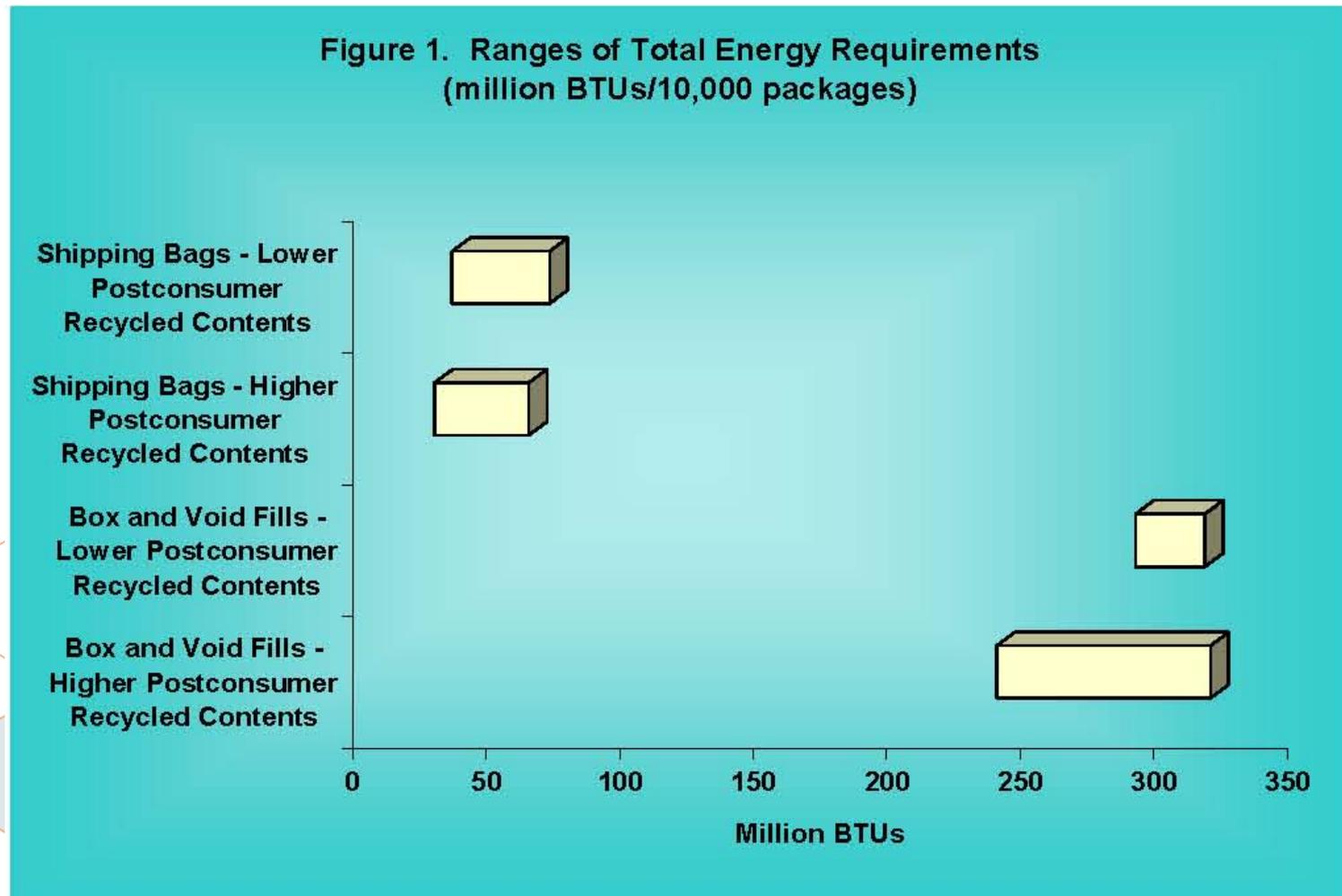
# Key findings

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- Shipping bags tend to have lower environmental burdens in most categories studied
- Increasing post-consumer content can reduce environmental burdens



# Life Cycle Inventory Energy Requirements per 10,000 packages for different categories of packages



# Findings – 3 important caveats people find surprising

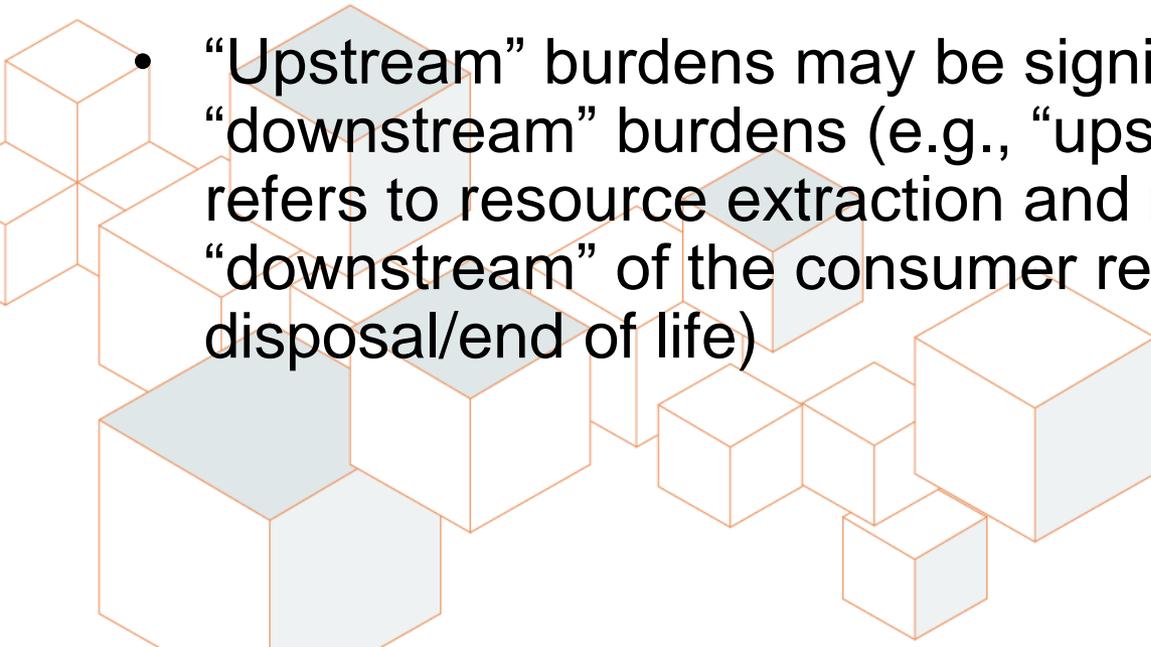
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- For businesses shipping in corrugated box with low post-consumer content, **using shipping bags offers significantly greater energy savings than increasing post-consumer content of the box and/or changing void fills**
- **Increasing post-consumer content doesn't guarantee reduced burdens in all environmental categories**
- **Materials with high levels of post-consumer materials are not guaranteed to have lower burdens than competing materials with low levels of post-consumer materials** (e.g., box shipped with molded pulp loose fill will require more energy over its life cycle than the same box shipped with virgin polystyrene or polyethylene void fills)

# More key findings

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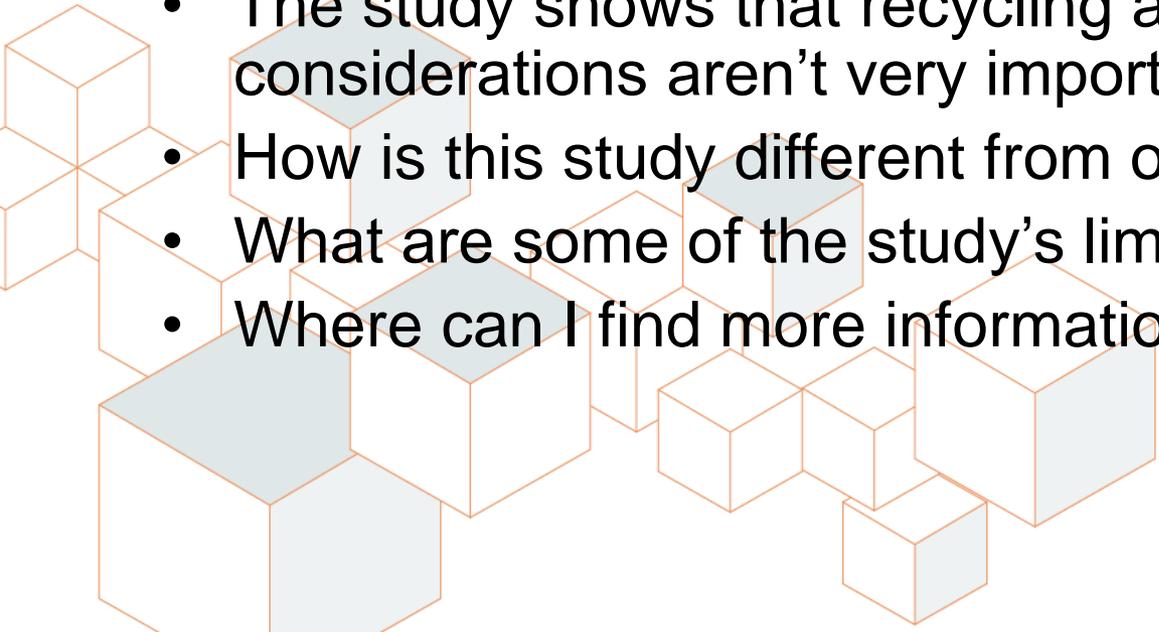
- Recyclability and recycled content are not always good predictors of environmental burdens
- Minimizing box size and total fiber content can result in significant environmental savings
- “Upstream” burdens may be significantly greater than “downstream” burdens (e.g., “upstream” of the consumer refers to resource extraction and manufacturing; “downstream” of the consumer refers to landfilling and disposal/end of life)



# Commonly Asked Questions (as a result of the LCA Oregon DEQ study)

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- So are shipping bags “better” than corrugated boxes?
- How can an all-plastic shipping bag have lower energy requirements than an all corrugated box with paper void fill? I thought plastic was made from oil, and paper comes from trees.
- The study shows that recycling and recycling considerations aren’t very important, correct?
- How is this study different from other life cycle studies?
- What are some of the study’s limitations?
- Where can I find more information?



# Why Life Cycle Thinking for Alternatives Assessment?

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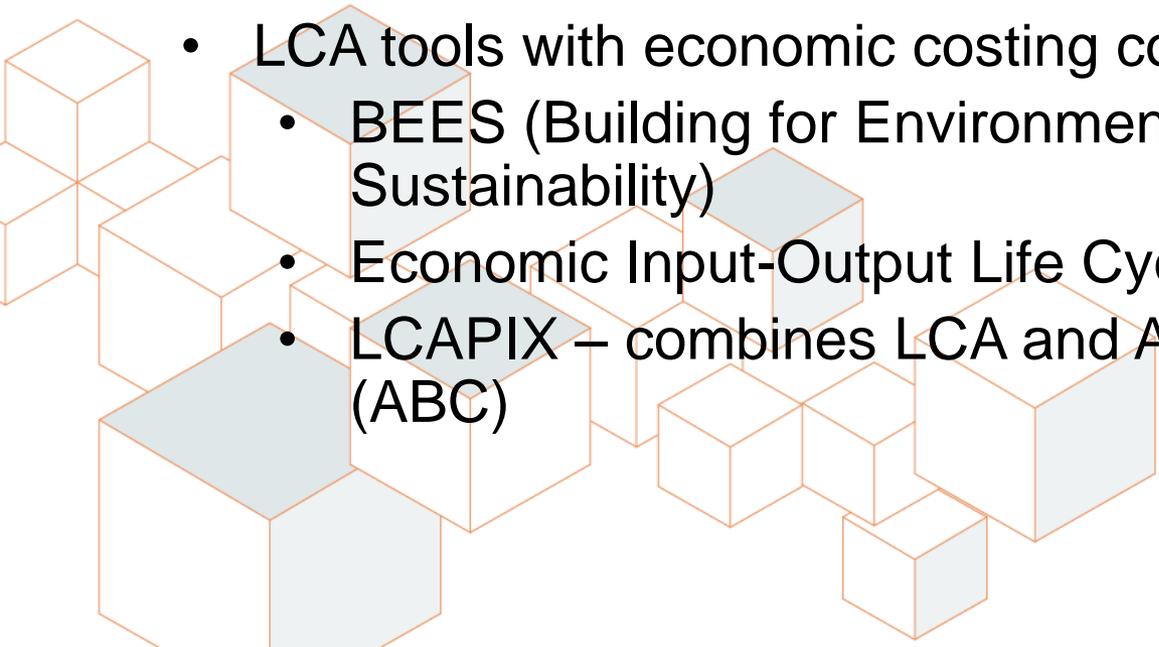
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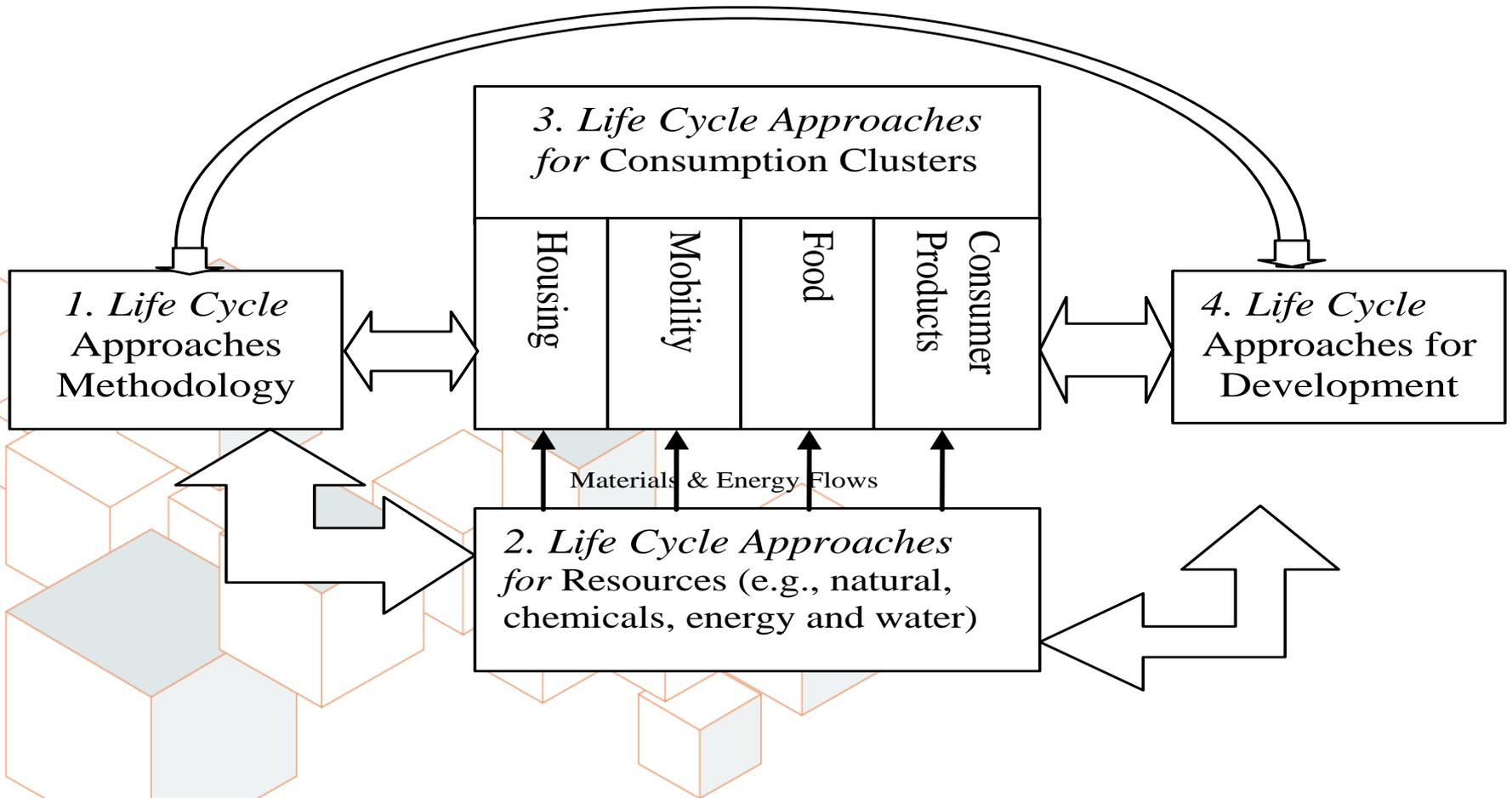
# LCA Software, Tools & Databases

<http://www.buildingecology.com/sustainability/life-cycle-assessment/life-cycle-assessment-software>

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- U.S. Life Cycle Database ([www.nrel.gov/lci](http://www.nrel.gov/lci))
- Additional tools & databases
  - SimaPro, Athena, Boustead Model, CMLCA, Eco-Indicator, Eco-Invent, Eco-Scan, GaBi, GEMIS, GREET model, IDEAMAT, IVAM, MIET, REGIS, SPINE, SPOLD, TEAM, Umberto, WISARD
- LCA tools with economic costing component
  - BEES (Building for Environmental & Economic Sustainability)
  - Economic Input-Output Life Cycle Assessment (EIO-LCA)
  - LCAPIX – combines LCA and Activity Based Costing (ABC)





# ACLCA – American Center for Life Cycle Assessment

## - educating all on LCA ([www.lcacenter.org](http://www.lcacenter.org))

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- ACLCA multistakeholder group – academia, NGOs, gov, industry, LCA consultants – 501(3)(C) under IERE
- Key role is annual conference on LCA
  - LCA XI, October 4-6, 2011, Chicago, IL
  - LCA 101 classes, certification, symposium
  - Opportunity for LCA presentations, posters
- ACLCA now certifying LCA professionals, and exploring program operator status for PCR's