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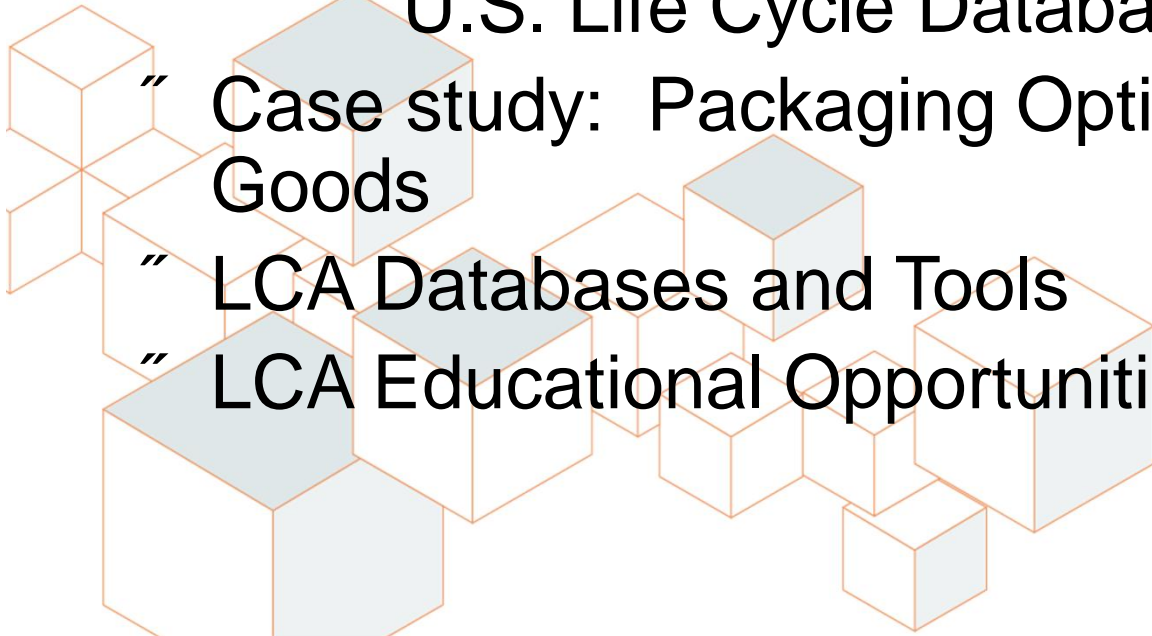
# Life Cycle (LCA) Thinking for Packaging Materials in Product Improvement Process

Mike Levy, ACC  
March 28, 2012

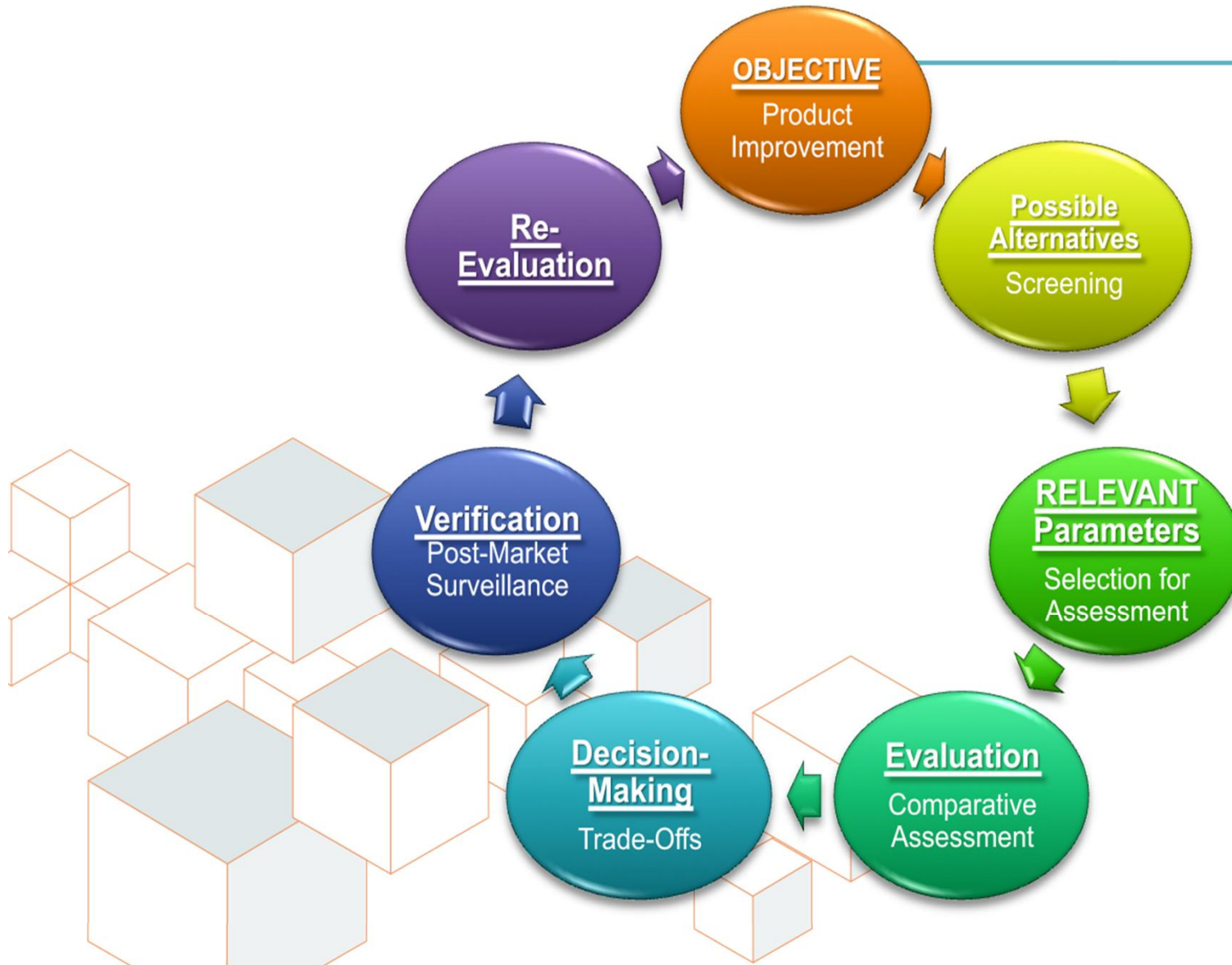


# Presentation Topics

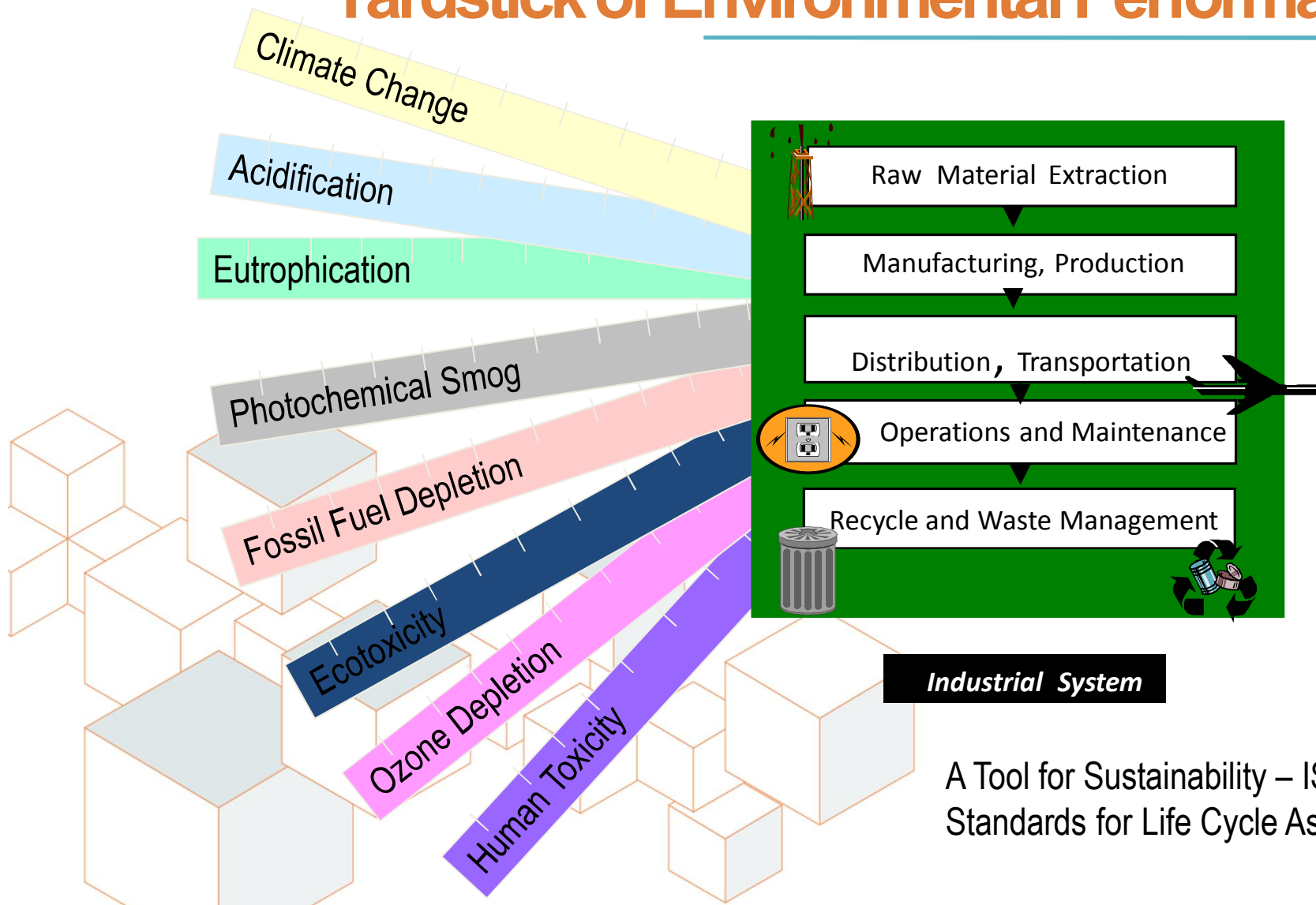
- “ Overview
- “ LCA thinking: a good fit for alternatives analysis
  - “ LCAs, LCI and ISO Standards
  - “ LCA data sources
    - “ Why ACC developed LCI data
    - “ U.S. Life Cycle Database
- “ Case study: Packaging Options for Shipping Soft Goods
- “ LCA Databases and Tools
- “ LCA Educational Opportunities



# Continuous Improvement



# Life Cycle Assessment: The Holistic Yardstick of Environmental Performance



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

# Multi-Factorial Evaluation Matrix – Key Criteria

## 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)

- Public Health Impacts, incl. sensitive subpopulations
- Environmental Impacts
  - Water quality impacts
  - Air emissions
  - GHG emissions
  - Waste/End-of-Life Disposal
- Toxicological endpoints
- Exposure Considerations
- Physicochemical properties

### (ii) Performance and Value

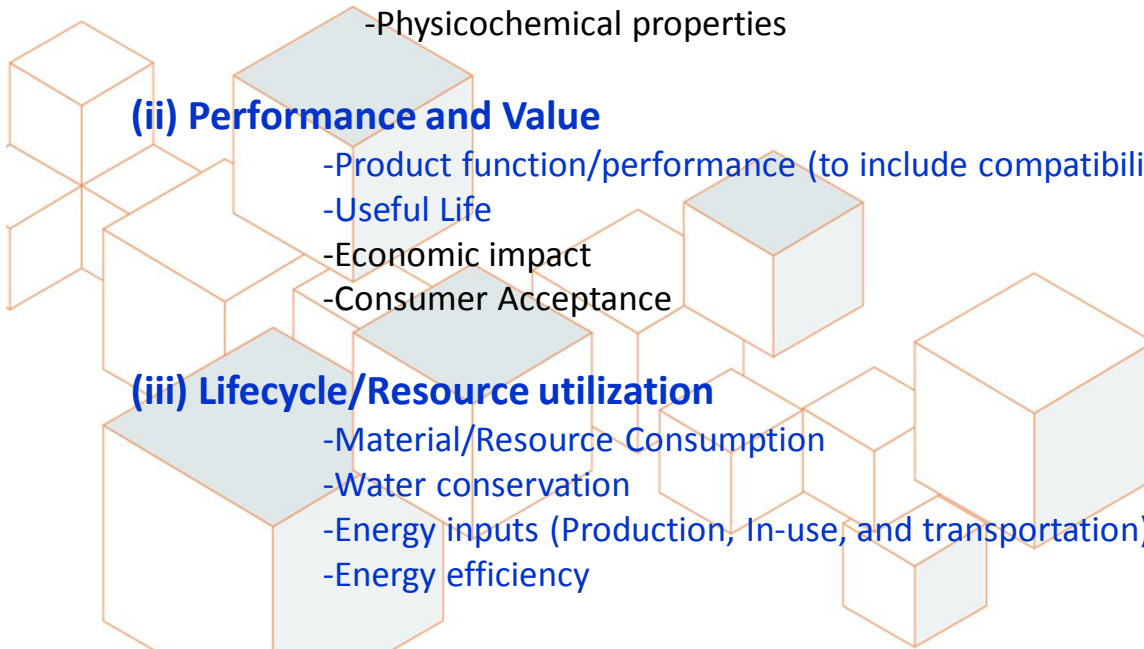
- Product function/performance (to include compatibility)
- Useful Life
- Economic impact
- Consumer Acceptance

### (iii) Lifecycle/Resource utilization

- Material/Resource Consumption
- Water conservation
- Energy inputs (Production, In-use, and transportation)
- Energy efficiency

### (iv) Other

- Availability/sourcing
- Manufacturing capability
- Regulatory compliance



# 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

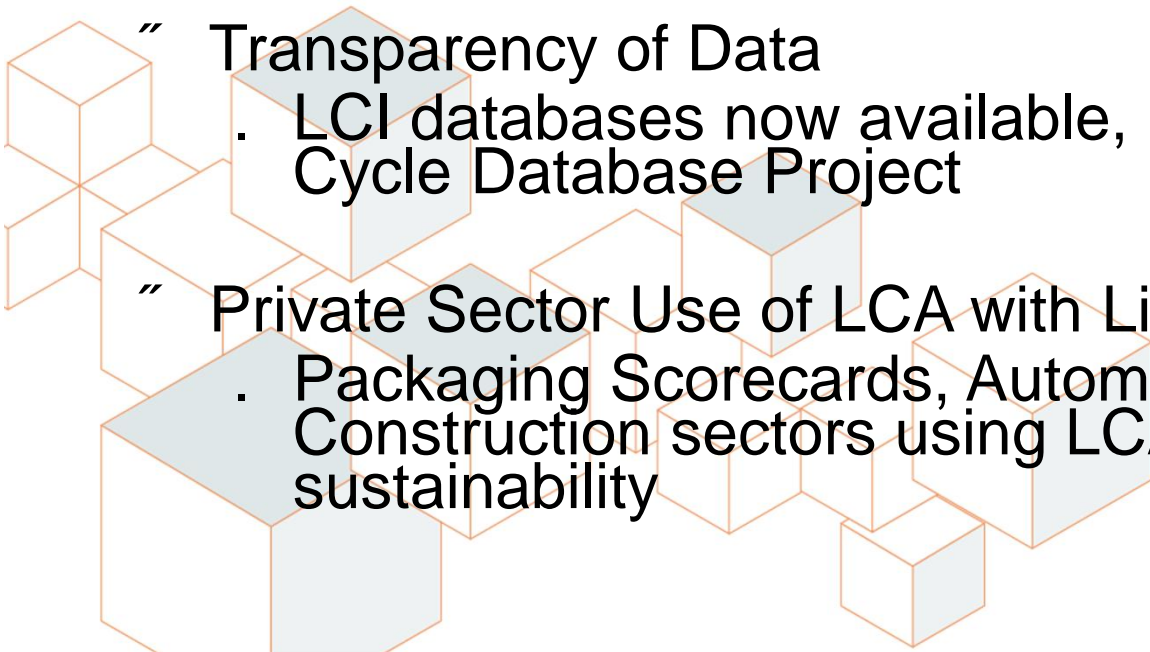
- . International standards for LCA - ISO 14044

## “ 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



# U.S. Life Cycle Database - Where Is It?

## [www.nrel.gov/lci](http://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 is located in the top right corner with a "Search" button and links for "More Search Options" and "Site Map". A sidebar on the left contains a menu with "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 text block describing the database's purpose: "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." Below this text is a link for a "Printable Version". At the bottom of the page, there is a statement: "This Web Site is Powered by Renewable Energy" and a footer providing information about NREL as a national laboratory of the U.S. Department of Energy, Office of Energy Efficiency & Renewable Energy, operated by Midwest Research Institute • Battelle. A footer menu includes links for "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](#)

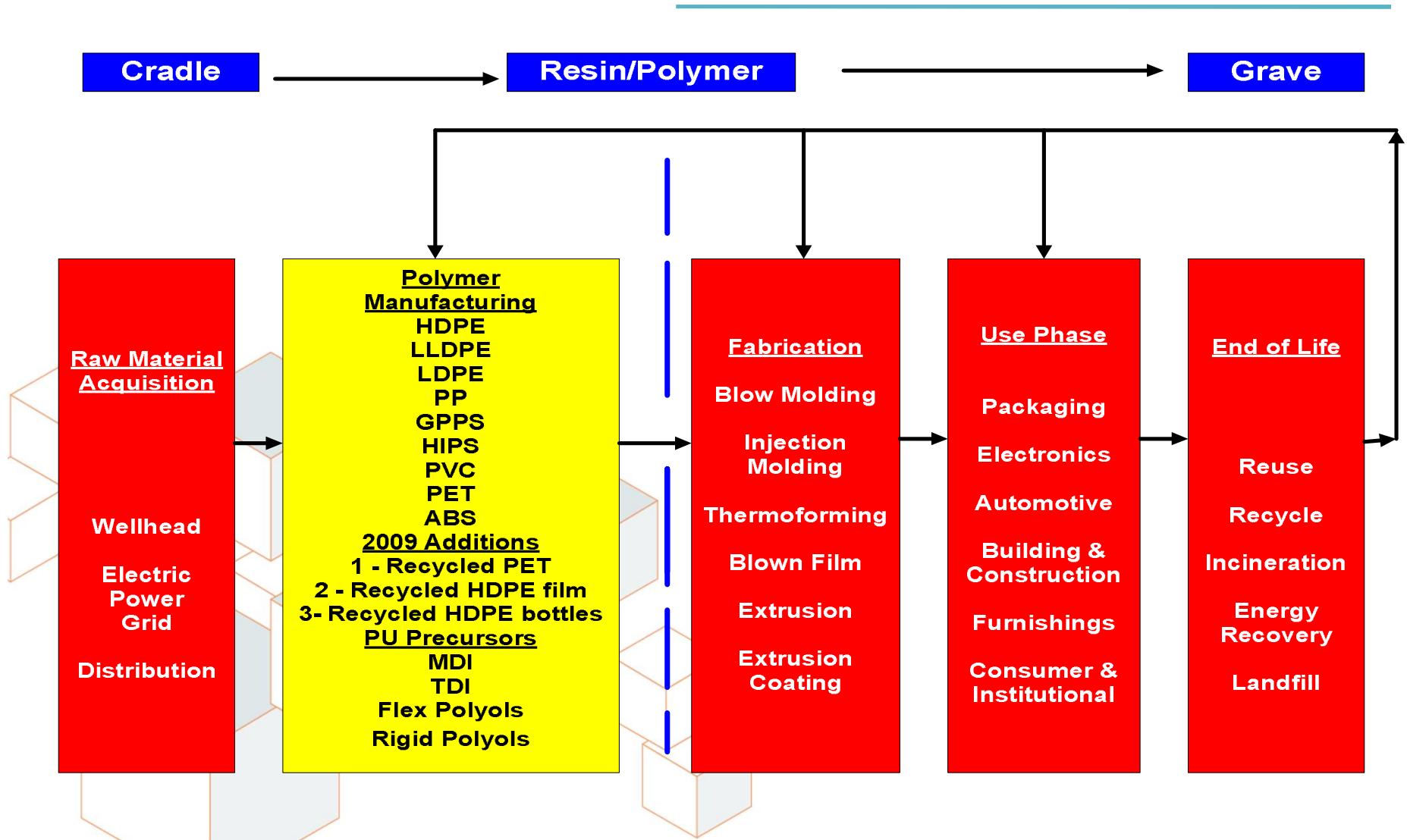
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Done

# 2011 Update: ACC Plastics Polymer & Polyurethanes LCI Database

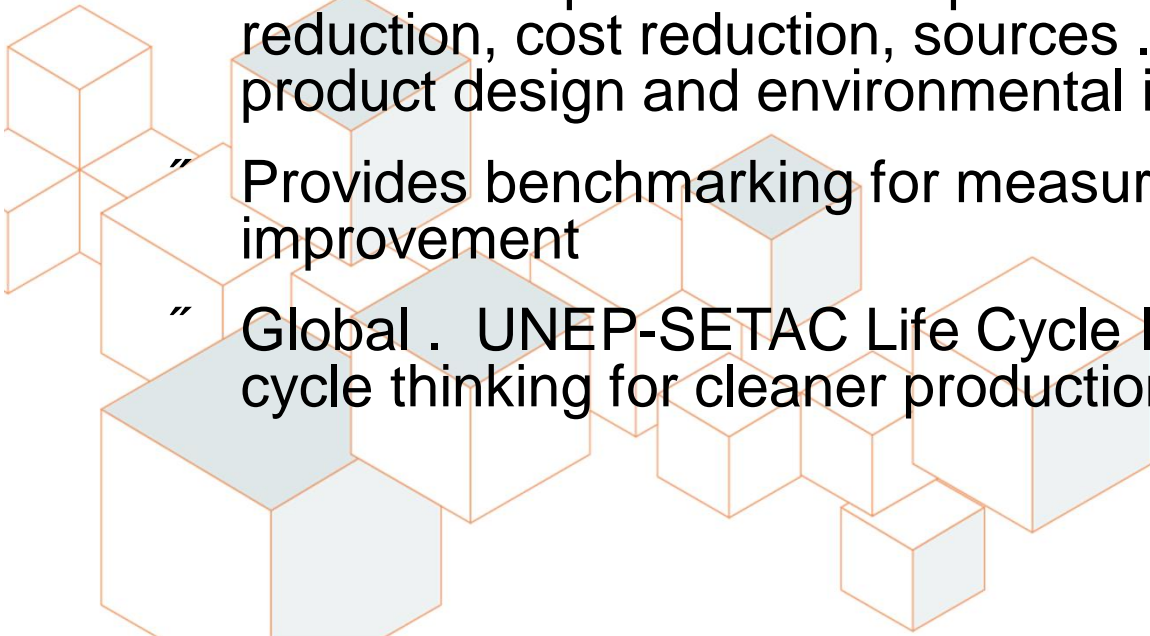




# Why Life Cycle Thinking for Alternatives Assessment?

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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

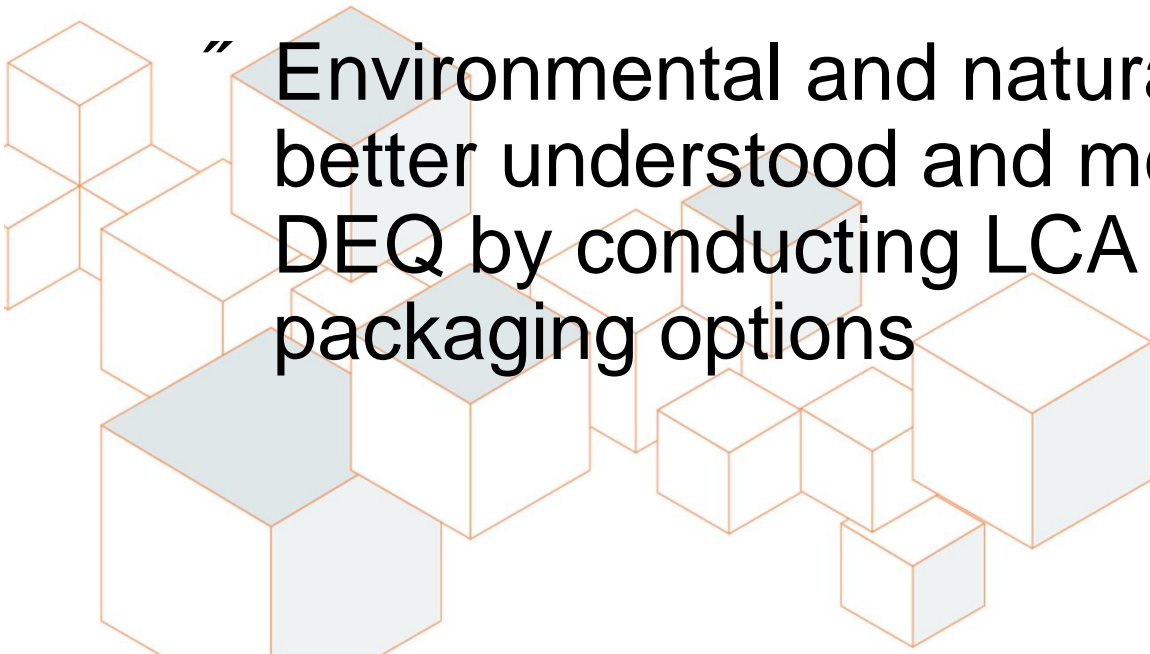


# Case Study: Oregon DEQ's Life Cycle Inventory of Packaging Options

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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:

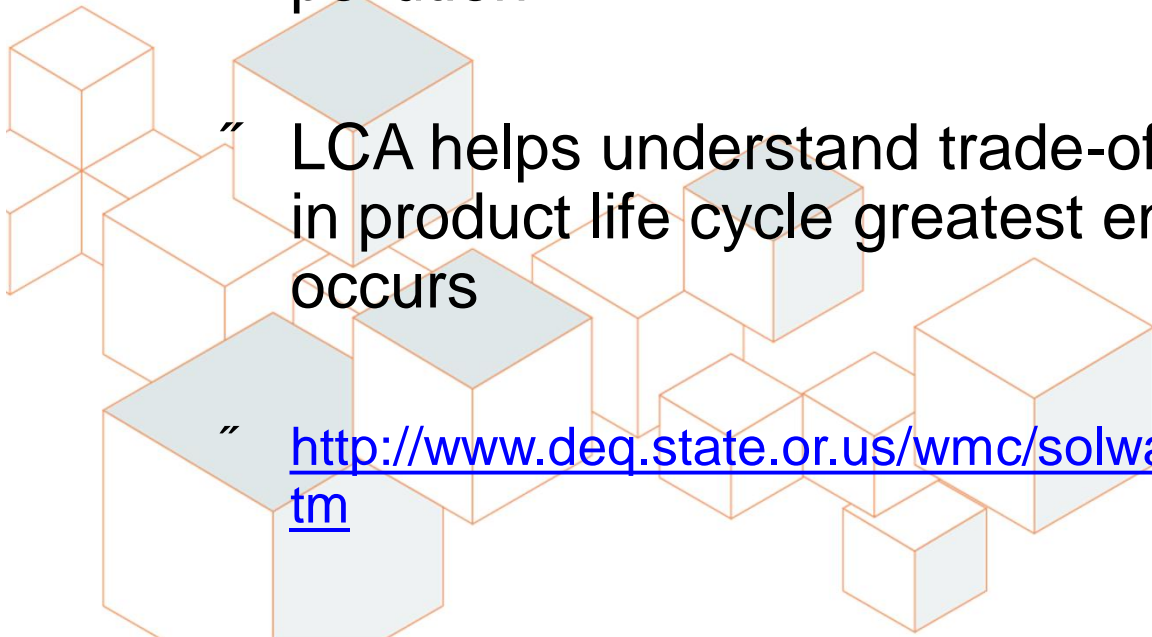
## Why LCA . because environmental challenges are complex

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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

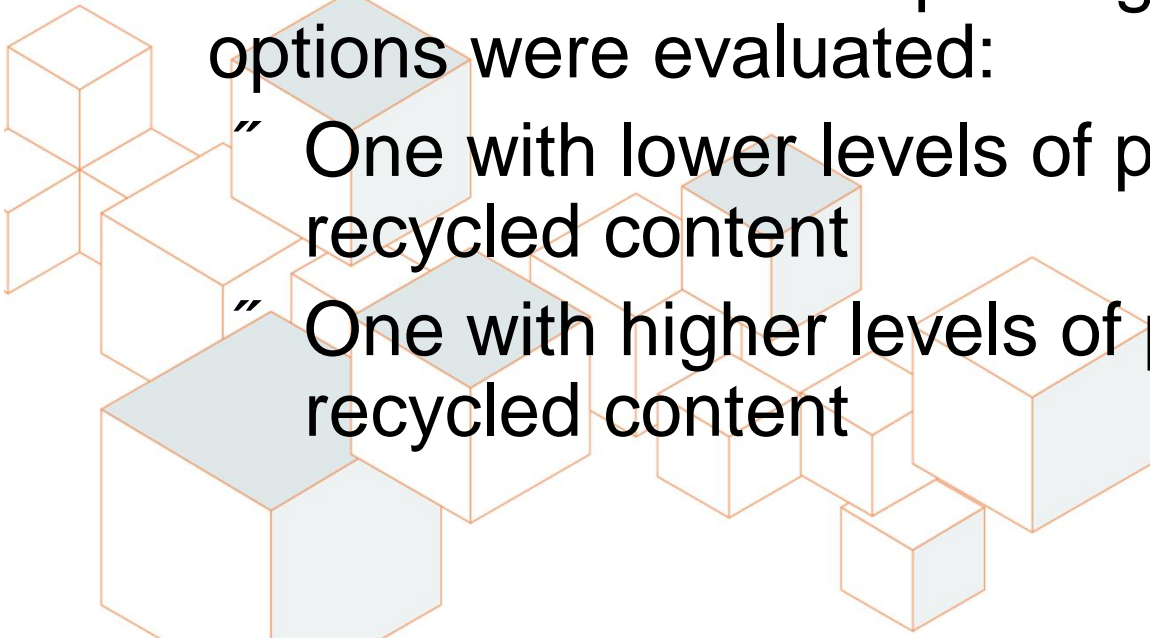
“ <http://www.deq.state.or.us/wmc/solwaste/data/LifeCycleReport.htm>



# 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

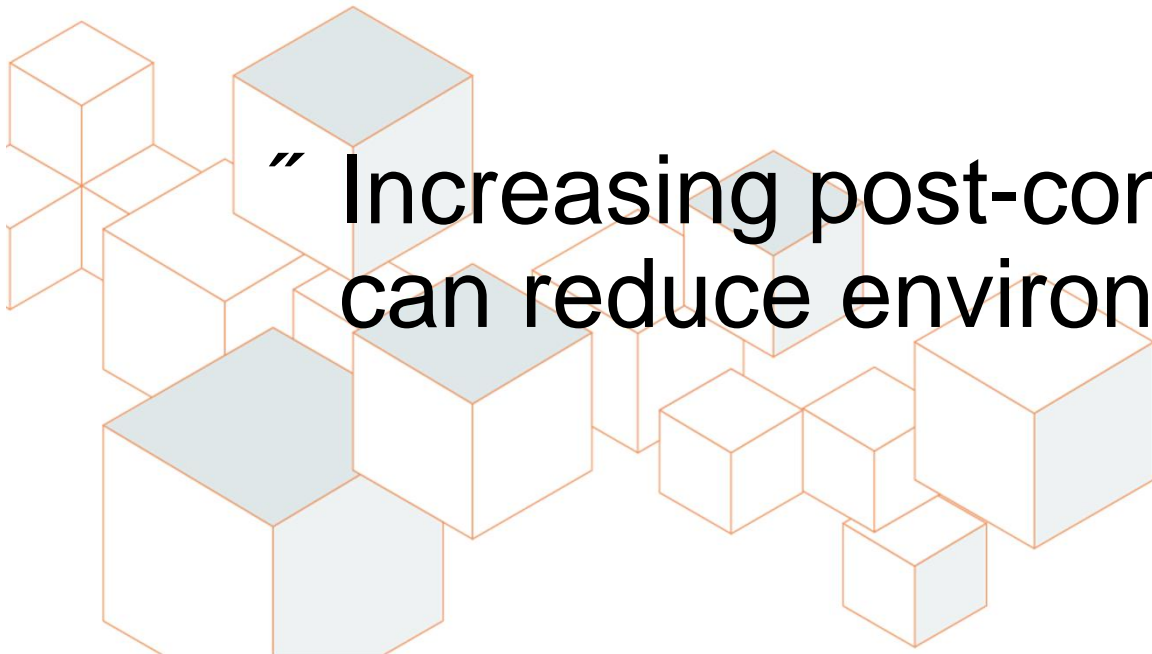


# Key findings

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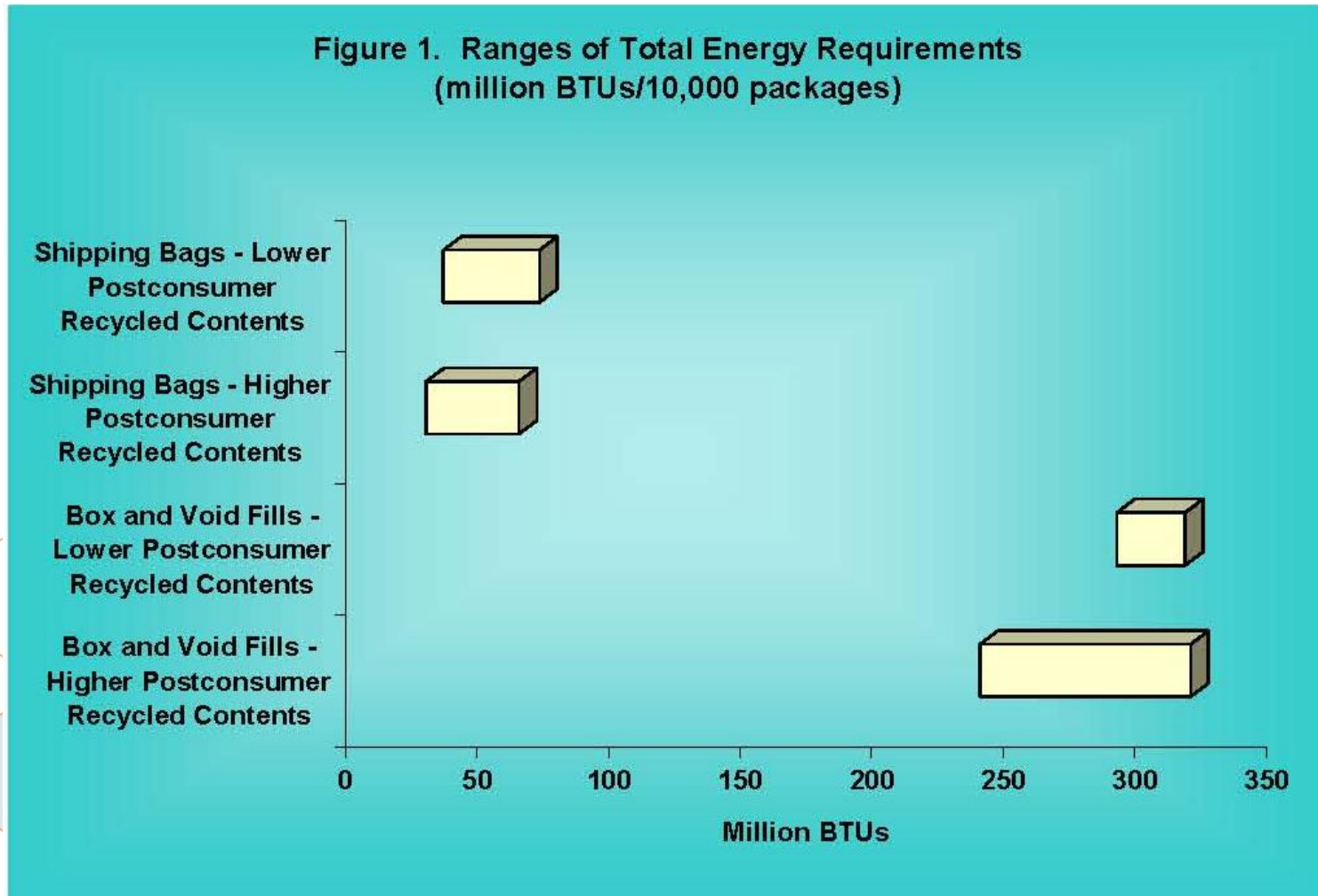
“ Shipping bags tend to have lower environmental burdens in most categories studied

“ Increasing post-consumer content can reduce environmental burdens



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

Figure 1. Ranges of Total Energy Requirements (million BTUs/10,000 packages)



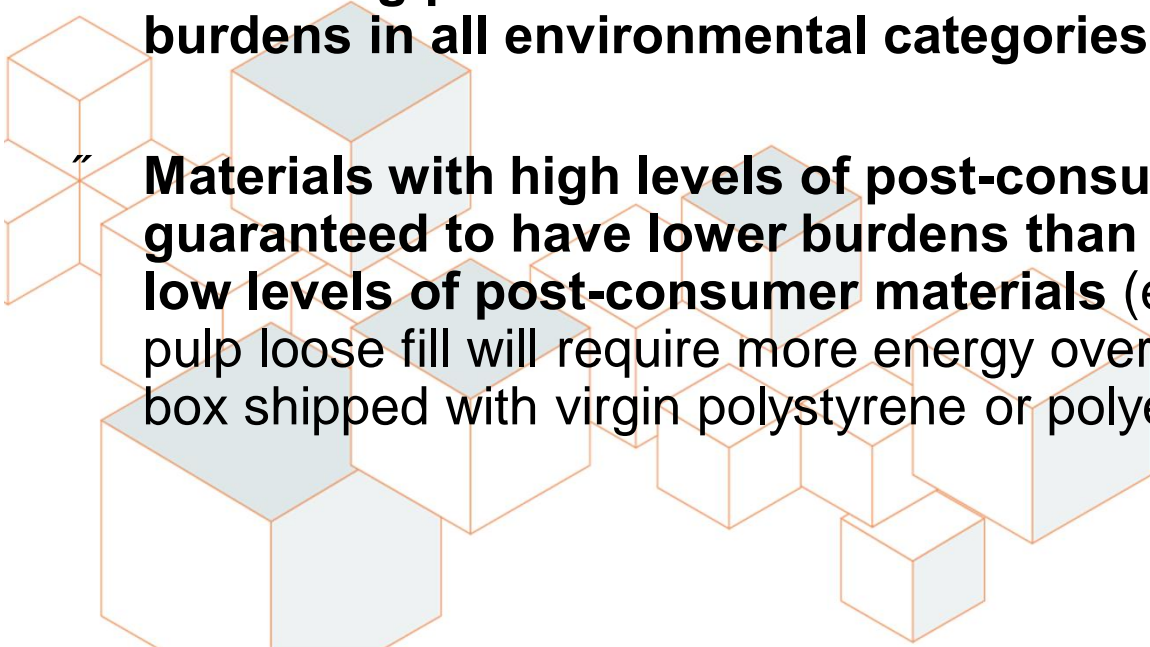
# Findings – 3 important caveats people find surprising

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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)



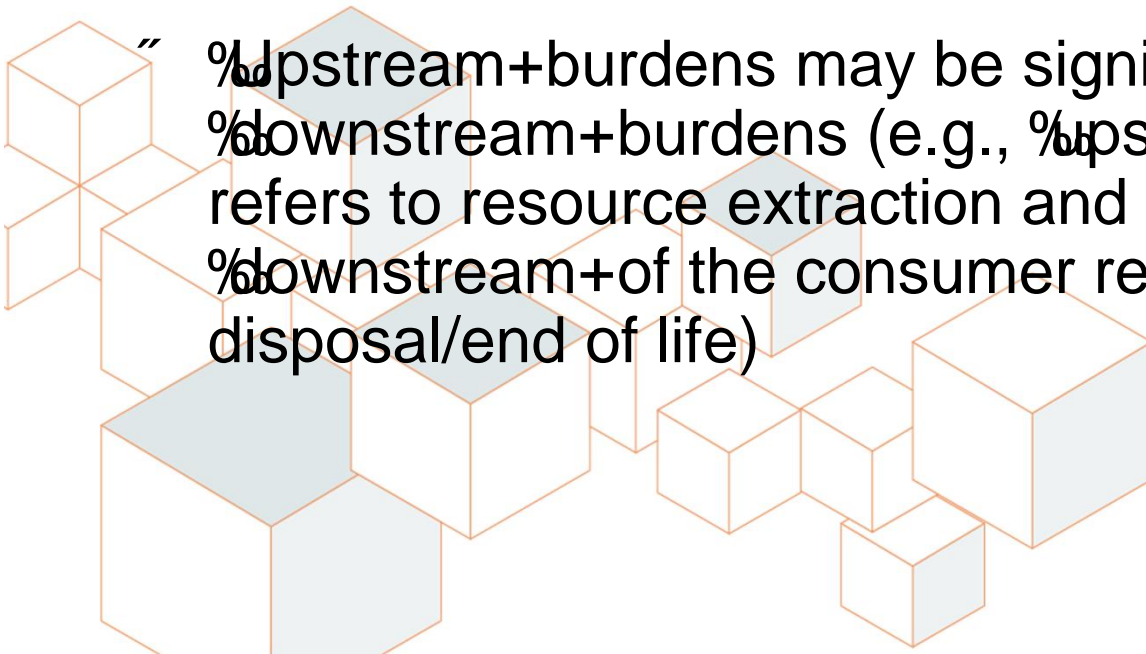
# More key findings

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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)

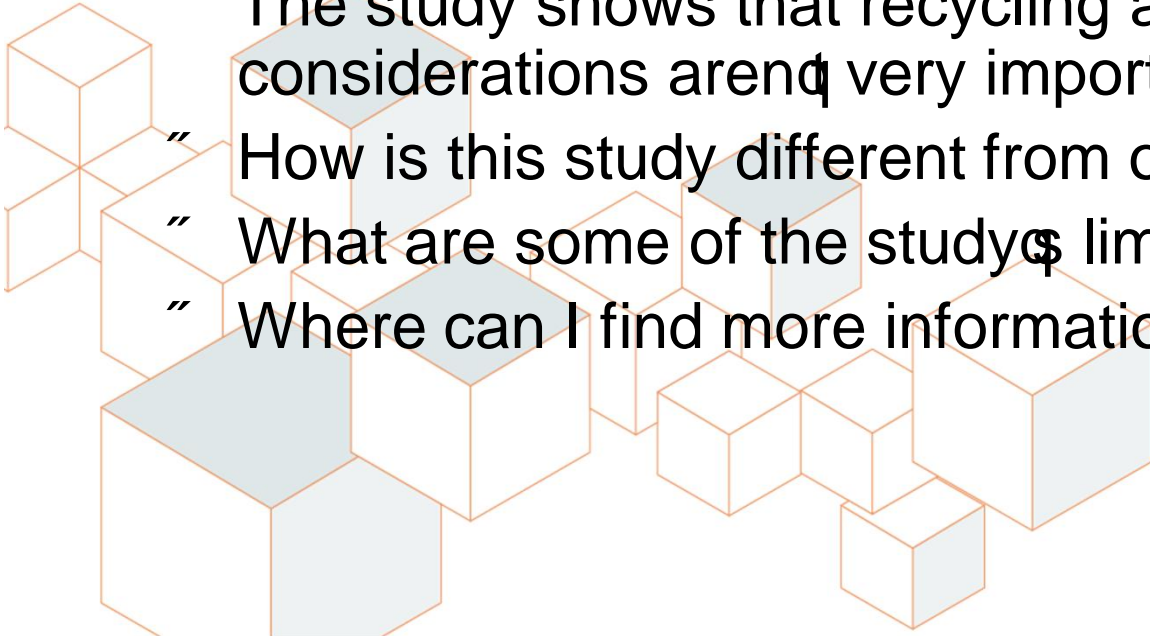




# Commonly Asked Questions (as a result of the LCA Oregon DEQ study)

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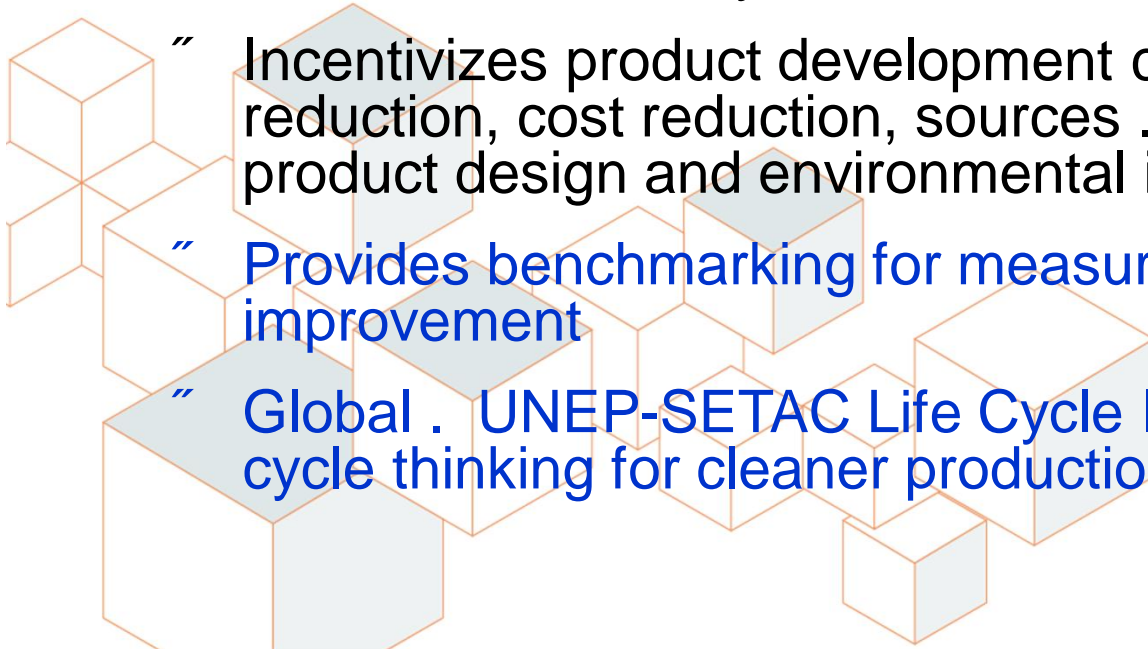
- “ So are shipping bags better than corrugated boxes?”
- “ How can an all-plastic shipping bag have lower energy requirements than an all corrugated box with paper void fill? I thought plastic was made from oil, and paper comes from trees.”
- “ The study shows that recycling and recycling considerations 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?”



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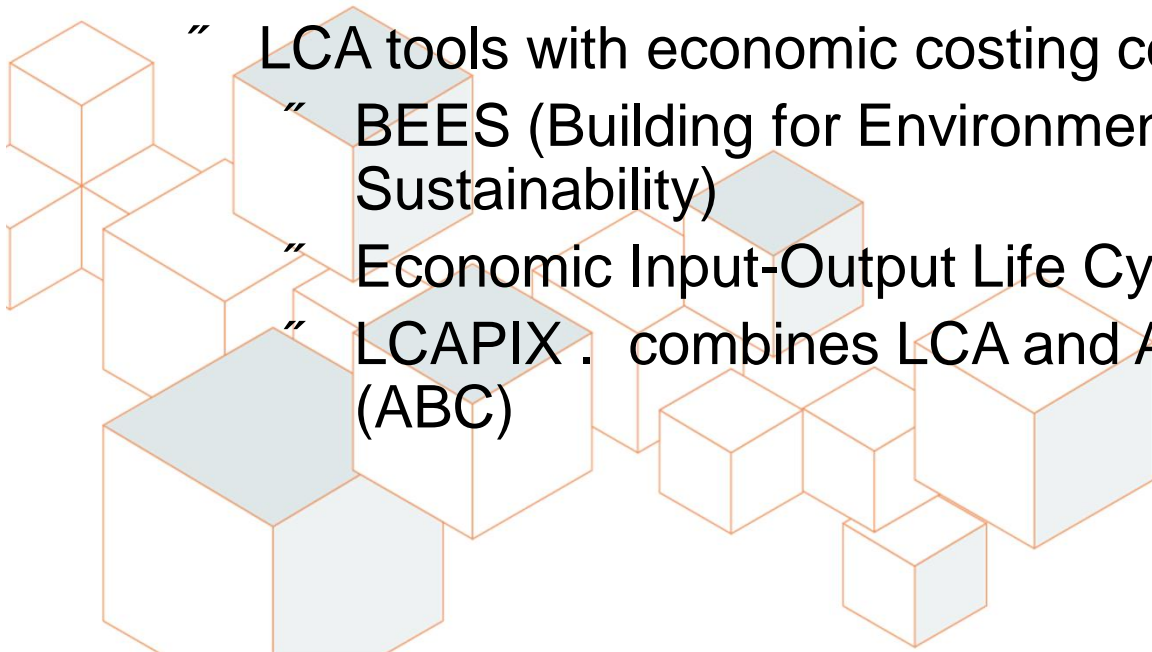


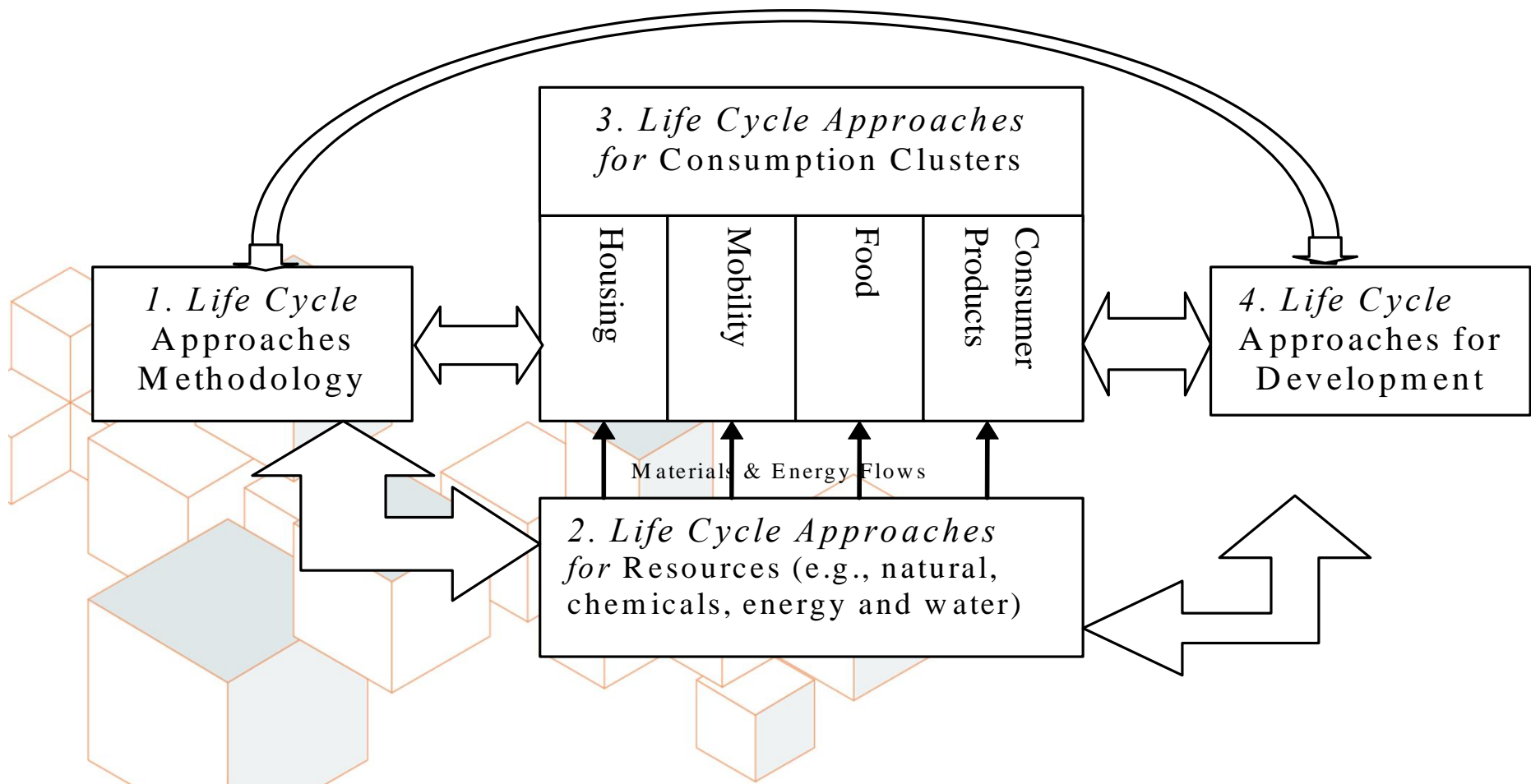
# LCA Software, Tools & Databases

<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 XII, Sep 25-27, 2012, Tacoma, WA
  - LCA 101 classes, certification, symposium
  - Opportunity for LCA presentations, posters
- ACLCA now certifying LCA professionals, and exploring program operator status for PCRAs

