LCA Informing Packaging Design
– a case study of COMPASS

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discussion agenda

• Packaging design and LCA
• Introduce COMPASS – a streamlined packaging LCA tool
  – Data processing
  – Scenario testing
  – Web application
• Discussion – limitations, drivers and opportunities, etc.
• Evidence of progress in the industry
• Perform a simple design evaluation
packaging design and LCA
life cycle of packaging
early market trend

• Post market eco-footprint, rank or score
shift to design evaluation

- Benchmarking of current packaging portfolio
- Use LCA to screen and optimize design choices
influence of design

(downstream) →

**BRANDS**
- image
- perception/loyalty

**DISTRIBUTION**
- transport efficiency
- product loss

**RETAIL**
- on shelf differentiation
- product shelf life
- safety

**CONSUMER**
- product appeal
- security
- satisfaction

**WASTE DISCARD**
- effective recovery
- reduce disposal
influence of design

(upstream)

MARKET SIGNALS
• demand for sustainable sourcing
• reduced energy intensity
• reduced impacts
• chain of custody
• transparency
the LCA tools space
characteristics of LCA tools

• Tools for LCA practitioners
  – Traditional actors: SimaPro and GaBi
  – Up and coming: OpenLCA and Earthster…
  – Audience and uses

• Streamlined LCA tools for packaging
  – COMPASS, PIQET, PackageSmart, Quantis…
  – Characteristics
  – Audience and uses
COMPASS®
Comparative Packaging Assessment
COMPASS
GREENBLUE®

a design-phase web application that provides comparative environmental profiles of packaging alternatives based on life cycle assessment metrics and attributes
background

• Starting points:
  – SPC member driven initiative for a science based
design evaluation tool
  – MERGE™ (Managing Environmental Resources,
Guidance and Evaluation)

• Data assessment
  – GreenBlue, USEPA, and Walmart
  – EPA funding for transparent LCI data
consensus based development

SPC’s Vision of Sustainable Packaging

Industry Expertise

Life Cycle Expertise

NGO Input

US EPA Support

Metrics
metrics relevant to packaging

**SPC Definition of Sustainable Packaging**

**Industry Expertise**

**Life Cycle Expertise**

**NGO Input**

**US EPA Support**

**CONSUMPTION METRICS**
- FOSSIL FUEL
- WATER
- BIOTIC RESOURCES
- MINERAL RESOURCES

**EMISSION METRICS**
- GREENHOUSE GASES
- HUMAN HEALTH
- AQUATIC TOXICITY
- EUTROPHICATION

**PACKAGING ATTRIBUTES**
- CONTENT
- SOURCE
- SOLID WASTE

**MATERIAL HEALTH**

LCIA: IPCC 2007, CEN/TR 14980, TRACI, USEtox
life cycle data processing
• Consistent background data modeling for common packaging materials and processes
• Apples to apples comparisons based on common functional unit
• Region specific solid waste profiles
• Verified by industry and external reviewers
data sets

• Data sets for U.S., Canada, Europe
  – México and China (coming soon!)
  – Background data from ecoinvent and USLCI

• End of Life (EoL) treatments for packaging
  – Landfill, WtE, compost, incineration, litter

• EoL solid waste profile
  – Regional recover and discard information from USEPA, EuroStat, StewardEdge Canada
materials and processes

- **Polymers**
  - HDPE, LDPE, LLDPE, PET, PP, PS, EPS, PVC, PVDC, PLA, EVA, Nylon 6, PC, Modified starch (Mater-bi)
- **Fibers**
  - Solid Bleached and unbleached Sulfate Board (SBS and SUS), Recycled Folding Boxboard, Corrugated, Supercalendered Paper, Bleached and Unbleached Kraft Paper, Liquid Packaging Board
- **Metals**
  - Steel and aluminum
- **Container glass**

- **Polymers**
  - Blow molding
  - Extrusion, plastic film
  - Foaming, expanding
  - Injection molding
  - Stretch blow molding
  - Thermoforming, with calendaring
- **Fibers**
  - Production of paper bags
  - Production of carton
  - Production of corrugated boxes
  - Cutting
- **Metals**
  - Sheet rolling
  - Production of steel can
the model
build scenarios using components

SIMPLE COMPONENTS

COMPOSITE COMPONENTS
packaging system

- PRIMARY PACKAGE
- SECONDARY PACKAGE
- PACKAGING SYSTEM
multipack scenario

COMPONENT A  x 6
- Bottle
- Label
- Cap

COMPONENT B  x 1
- Carry case
reuse scenario

**Waste Reduction Model**
The entire package is reused and is refilled from another package (forms and capacity can vary).

**Extended Life Model**
A critical component(s) is reused while the rest of the components are discarded and replaced with a refill package.

Refill scenarios requiring washing or industrial cleaning are excluded.
distribution

<table>
<thead>
<tr>
<th>MODE</th>
<th>VEHICLE</th>
<th>DISTANCE:</th>
<th>FUEL:</th>
<th>DATA:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Road</td>
<td>relevant trucks to the region</td>
<td>km and m</td>
<td>diesel, gasoline, kerosene, other as available</td>
<td>USLCI and ecoinvent</td>
</tr>
<tr>
<td>Rail</td>
<td>freight train</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sea</td>
<td>barge and transoceanic freight ship</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Air</td>
<td>cargo plane</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
life cycle coverage in COMPASS
the web application
key features

• Compare up to four scenarios simultaneously
• View impact of components in relation to the package
• Assess life cycle consumption and emission metrics and key attributes
• Include distribution impacts
• Capture pertinent details in spreadsheet format
• Easy to use secure web-based application
• Assessment transparency with full documentation
• Detailed video tutorials
compare read-to-eat soup packaging

Primary Packages
- Can body
- Pull tab
- Paper label

Secondary Packages
with poly wrap
components in relation to package
life cycle impacts profile

Functional Unit of Comparison: 4 SERVING SIZE

- Manufacture
- Conversion
- Distribution
- End of life

Fossil Fuel
Water
Biotic Resources
Minerals

GHG
Human Health
Aquatic Toxicity
Eutrophication
packaging attributes

Packaging Attributes & Material Health

Functional Unit of Comparison:
4 SERVING SIZE

- 1 unit(s) of LAMINATED ASEPTIC PACK
- 4 unit(s) of MICROWAVABLE SOUP
- 2 unit(s) of STEEL CAN

Virgin or Recycled Content

Source Certification

Source Certification

Material Health

<table>
<thead>
<tr>
<th>Material Health</th>
<th>Weight</th>
<th>C</th>
<th>R</th>
<th>PBT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0 unit(s) of LAMINATED ASEPTIC PACK</td>
<td>104.50g</td>
<td>4</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4.0 unit(s) of MICROWAVABLE SOUP</td>
<td>148.00g</td>
<td>5</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>2.0 unit(s) of STEEL CAN</td>
<td>69.00g</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

C: Carcinogen
R: Reproductive Toxicant
PBT: Persistent, Bioaccumulative, and Toxic
material health

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<th>C</th>
<th>R</th>
<th>PBT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0 unit(s) of LAMINATED ASEP TIC PACK</td>
<td>104.50g</td>
<td>4</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>CAP AND POUR SPOUT</td>
<td>4.00g</td>
<td>1</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Polypropylene (PP)</td>
<td>4.00g</td>
<td>1</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Heavy fuel oil</td>
<td></td>
<td>1</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Burned in industrial furnace; not present in final material</td>
<td></td>
<td>1</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>CARTON</td>
<td>100.00g</td>
<td>3</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>FOIL SEAL</td>
<td>0.50g</td>
<td>0</td>
<td>0</td>
<td></td>
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Project Info

Package Info

Summary Charts
- LC
- Attributes
- Components

Detail Sheets

Summary
Analysis sheets
Scenarios
transport model (being developed)

Add distribution related transport for components, packages and shipping the system to the DC
limitations and opportunities
discussion

• Limitations
  – Current and representative life cycle inventory (LCI)
  – Data transparency and uncertainty
  – Impact categories: water, human and eco-toxicity, land use

• Drivers
  – Retailer and corporate scorecards
  – Global Packaging Protocol for Sustainability (GPPS)
  – The Sustainability Consortium (TSC)

• Opportunities
  – Measurements ≠ Sustainability
  – Use LCA to improve environmental performance of package and product, DfE and/or DfR, not for making claims
  – Informing public policy
evidence of progress

• Emphasis
  – Material selection based on key environmental indicators
  – EoL outcome of design

• Corporate sustainability agenda
  – Baseline of packaging portfolio
  – Informing procurement policies
  – Material input efficiency and waste reduction
  – Environmental indicators as SOP

• Educational emphasis on design and LCA
  – RIT, MSU, Univ. of Florida

• International developments
pause for a quick demo
task: deliver 12 oz of juice product

Glass  aluminum  liquid paperboard  composite  plastic
COMPASS: https://design-compass.org
SPC: www.sustainablepackaging.org
GreenBlue: www.greenblue.org