Sustainable Packaging : The Pros and Cons of EPS Alternatives

Plastic Pollution Prevention Summit

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What are the EPS Alternatives?

Food and beverage packaging alternatives:

- Polystyrene- non foamed
- Polyethylene
- Paper and molded fiber
- Bio-based, compostable plastics
- Aluminum
- Glass
- Re-usable ceramic, glass, plastic

Sustainable Packaging Drivers

- Green Chemistry
- EU Directive on Packaging and Packaging Waste
- Consumer consciousness EU- planning for sustainable consumption

How to Assess the Alternatives?

What's the problem you are trying to solve?

- Litter and marine debris?
- Increase recycling?
- Increase diversion?
- Protect public health?
- Reduce Environmental impacts? *acidification, carcinogens, ecotoxicity, eutrophication, global warming, other pollutants, ozone depletion, respiratory effects, smog, fossil fuel depletion, water footprint, carbon footprint*
- Promote Green Design? *waste prevention, material efficiency, avoid hazardous materials, maximize energy efficiency, use renewable resources, design for recycle, use local resources*

Definitions of Sustainable Packaging

An Array of Definitions and Tools

- Sustainable Packaging Coalition- from cradle to cradle
- SCP – UNEP Sustainable Consumption and Production
- SJC – SC Johnson Company
- Wal-mart - Sustainable Packaging
- SPA – Sustainable Packaging Alliance- Australia
- Sustainable Biomaterials Collaborative – Sustainable Packaging
- Biz-NGO Working Group on Sustainable Materials

Defining Sustainable Packaging

Sustainable Packaging Alliance:

Effective: social and economic benefit – the packaging system adds real value to society by effectively containing and protecting products as they move through the supply chain and by supporting informed and responsible consumption.

Efficient: doing more with less – The packaging system is designed to use materials, energy and water efficiently throughout the product life cycle. Efficiency can be defined through reference to world's best practice at each stage of the packaging life cycle.

Cyclic: optimising recovery – Packaging materials used in the system are cycled continuously through natural or industrial systems, with minimal material degradation. Recovery rates should be optimised to ensure that they achieve energy and greenhouse gas savings.

Safe: non-polluting and non-toxic – Packaging components used in the system, including materials, finishes, inks, pigments and other additives do not pose any risks to humans or ecosystems. When in doubt the precautionary principle applies.

SC Johnson Sustainable Packaging Definition

- *Sustainable packaging*:
  - Is capable of being produced indefinitely by the planet;
  - Does not pollute the planet or damage the environment;
  - Is sourced, manufactured, transported and recycled using renewable energy sources which are non-polluting; and
  - Meets the market criteria for performance and cost or the trade-off for environment friendliness is minimal.
- Goals:
  - SCJ set 5 year goal to achieve 34% improvement in raw materials score of products as measured by Greenlist™ process (by 2012)

Sustainable Packaging Defined by SPC

- Is beneficial, safe and healthy for individuals and communities throughout its life cycle;
- Meets market criteria for performance and cost;
- Is sourced, manufactured, transported, and recycled using renewable energy;
- Maximizes the use of renewable or recycled source materials;
- Is manufactured using clean production technologies and best practices;
- Is made from materials healthy in all probably end of life scenarios;
- Is physically designed to optimize materials and energy;
- Is effectively recovered and utilized in biological and/or industrial cradle to cradle cycles.

- GOAL OF SPC: “to advocate and communicate a positive, robust environmental vision for packaging and to support innovative, functional packaging materials and systems that promote economic and environmental health through supply chain collaboration.”

Who is Defining Packaging Sustainability?

In the absence of government action, sustainable packaging initiatives are being:

- driven by the private sector, mostly organizations that serve large consumer product manufacturers

- supported by retailers and brand owners who feel they can act more quickly, and with more positive results, than governments- and control the outcome

Sustainable Packaging Coalition

• Merck • Aeroclay, inc. • Metabolix • AET Films, Inc. • Michigan State University School of Packaging • Alcan Packaging, Inc. • Microsoft • Alcoa Rigid Packaging Division • Millwood Inc. • Altria • Mississippi River Pulp • Amcor • ModusLink Global Solutions • American Packaging Corporation • Molded Fiber • Amerikal Products Corporation • M-real Corporation • AMGRAPH Packaging, Inc • Multi-Color Corporation • Associated Packaging Technologies • MWV • Atlantic Packaging • NatureWorks • Avery Dennison • Naturopathica Holistic Health • Avon Products Inc • Nestlé Purina • Ball Corporation • New Chapter, Inc. • BASF Corporation • NewPage Corporation Specialty Papers • Be Green Packaging LLC • NextLife Packaging Group • Bemis Company, Inc. • Nike • Berry Plastics • NORDENIA U.S.A., Inc. • Biolithe LLC • Nu-Life North America • Burt's Bees • OEC Graphics • Cadbury plc • O-I • California Department of Resources Recycling and Recovery (CalRecycle) • OIA Global Logistics - Creative Packaging Solutions • Capital Corrugated • Omya • Caraustar Industries Inc. • Ongweoweh Corporation • CardPak, Inc. • Orbis Corporation • Cedap Mexico SA de CV • PACCESS Packaging • Checkpoint • Pacific Southwest Container • CHEP Equipment Pooling Systems • Packaging & Technology Integrated Solutions, LLC (PTIS) • Church & Dwight Co., Inc. • Packaging 2.0 LLC • Clean Agency • Packaging Corp. of America • Clear Lam Packaging, Inc. • Packaging Dynamics • Clif Bar & Co. • Packstar • Clorox Company, The • Pactiv Corporation • Coating Excellence International • Pakit, Inc. • Coca-Cola Company, The • Palermo's Pizza • Combined Technologies, Inc. (CTI) • PepsiCo • Competitive Innovation • Phoenix Technologies • ConAgra Foods • pigeon*branding+design • Consolidated Container Co. • pkg • Container Centralen, Inc • PKG Packaging Knowledge Group, LLC • Costco Wholesale • Plastic Ingenuity • C-P Flexible Packaging • Plastic Suppliers, Inc. • CPT, Inc. • Pratt Industries • Crown Holdings, Inc. • precision color graphics • Curtis Packaging • Presto Products Company • DaniMer • Printpack, Inc. • Dart Container Corp. • Procter & Gamble • Dell • Product Ventures • Design and Source Productions • R. W. Beck • Diversified Graphic Machinery • Rainbow Light Nutritional Systems, Inc. • Domtar - Technical, Specialty and Premium Papers • Raison Pure International • Dordan Manufacturing Company Inc. • Rebox Corporation • Dow Chemical Company • REI • DuPont • Ring Container Technologies • Duro Bag Manufacturing Company • Robbie • Eagle Flexible Packaging • Rochester Institute of Technology • Earthbound Farm • RockTenn Company • Earthcycle Packaging Ltd. • Rohrer Corporation • Eastman Chemical Co. • Rosmar Packaging • Ecovative • SABMiller • ECRM • Sara Lee Corporation • Eli Lilly and Company • SC Johnson • Emerald Packaging, Inc. • Scholle Packaging, Inc. • Environmental Inks and Coatings • Sealed Air Corporation • Environmental Packaging International • Select Product Group, LP • E-pac (Far East) Co., Ltd • Seventh Generation • Equity Packaging, Inc. • Seydel Companies, The • EskoArtwork • Shaklee • Estée Lauder Companies, The • Shanghai Luxin Evotech Packaging • Exopack Holding Corp. • Shurtape Technologies, LLC • Expandos • SIG Combibloc • ExxonMobil Chemical Co. • Silgan Holdings, Inc. • Fabri-Kal Corporation • SKC inc. • FIT • Smurfit-Stone Packaging Corporation • Flint Group • Snohomish County • Fort Dearborn Company • Solo Cup Company • Fres-Co System USA, Inc. • Sonoco Products Company • General Mills, Inc. • Spartech Corporation • Georgia-Pacific Packaging • Specialized Packaging Group, Inc., The • Graham Packaging Company L.P. • Spectra-Kote • Graphic Packaging International • Staples • Green Mountain Coffee Roasters • Starbucks Coffee Company • Haney PRC • stonyfield farm • Hedwin • StopWaste • Henkel Corporation • Sun Chemical Corporation • Heritage Plastics • Sun Hing Printing Company Limited • Holmes & Marchant Asia Pacific • Syngenta • Horizon Converting • Taminco NV • Huhtamaki • Target • IFCO Systems N.A., Inc. • Tetra Pak • iGPS • Tomra North America • IMEX Packaging • Transparent Container • Industrial Packaging • Transparent Packaging • Innovia Films • Treofan Americas • Intel Corporation • TricorBraun • International Paper • True Blue • Interstate Resources, Inc. • Tullis Russell Papermakers • INX International Ink Co. • Two C Pack Systems • ITW • U.S. Corrugated, Inc. • Johnson & Johnson • U.S. Department of Commerce - International Trade Administration • Kellogg Company, The • U.S. Environmental Protection Agency • Kimberly-Clark Corporation • Unilever • Klöckner Pentaplast • Union Street Brand Packaging • Kraft Foods Global Inc. • Unisource Worldwide Inc. • LBP Manufacturing, Inc. • Univenture, Inc. • Litco International, Inc. • UPS • Longview Fibre Paper and Packaging, Inc. • Utah Paperbox • Markem-Imaje • Wausau Paper • Marks and Spencer Group Plc • Webb Scarlett deVlam • Mattel, Inc. • Western Michigan University • McCormick & Company, Inc. • WhiteWave Foods • McDonald's • Winterborne, Inc. • McNairn Packaging • Yum! Brands, Inc. •

EUROPEN
Sustainable Packaging Guide

RETAILERS
ALLIANCE BOOTS
ASDA
CARREFOUR
INEX PARTNERS
MARKS & SPENCER
REWE
RIMI BALTIC
TESCO STORES

PACKAGED GOODS MANUFACTURERS
BACARDI
COCA-COLA HELLENIC
COLGATE PALMOLIVE
DANONE
DIAGEO
ENERGIZER
HENKEL
JOHNSON & JOHNSON
NESTLE
L'OREAL
PROCTER & GAMBLE
UNILEVER

PACKAGING MATERIAL SUPPLIERS & PACKAGING MANUFACTURERS
BALL PACKAGING EUROPE
EXXONMOBIL CHEMICAL FILMS
NATUREWORKS
SCA PACKAGING
STI GROUP
STORA ENSO
TETRA PAK

INDUSTRY AND TRADE ORGANISATIONS
AIM
ECR FRANCE
ECR EUROPE
EHI RETAIL INSTITUTE
EUROCOMMERCE
EUROPEN
FEVE
FLEXIBLE PACKAGING EUROPE
GS1 BELGILUX
IGD / ECR UK

Different approaches to evaluating what is a sustainable package

Design Guidelines:

- Sustainable Packaging Coalition (U.S.)
- WRAP (UK Waste and Resources Action Program) Guide to Evolving Packaging Design
- SC Johnson Greenlist
- Johnson & Johnson
- Incpen Responsible Packaging Code of Practice, Global Packaging Project

Regulations:

- EU Directive on Packaging and Packaging Waste, similar regulations in Canadian provinces

Scorecards: Wal-Mart packaging scorecard, SCJ Greenlist

Life Cycle Tools and Software:

- SPC's Compass
- WalMart uses MERGE
- BASF's eco-efficiency
- Sustainable Packaging Alliance's PIQET
- International Standards Organization (ISO)

Different Types of Tools to Assess Sustainability of Packaging

- Packaging Design Tools
  - Provide directional guidance (e.g. COMPASS / SPC)
  - ISO 14000- (14040 + 14044)
  - Packaging Environmental Indicator (EU)
- Packaging Procurement Tools
  - Provide weighted hierarchy (e.g. Scorecards)- Walmart
  - Use data from metrics of interest
- Life Cycle Tools to Assess the Package
  - Provide comprehensive LCA (e.g. Gabi- PE Int'l)
  - Use full database information (e.g. Eco-Invent, LCI inventory)

No one size fits all approach

Wide range of factors to consider/ i.e. information needs:

- Life cycle costs: capital equipment, product loss, recycling, infrastructure
- Technical assessment (fit for purpose, safety, transport, storage)
- Life cycle impacts (GWP, ODP, primary energy, waste)
- Social factors (supply chain, labor, health and safety)
- Risk assessment: eco-toxicity, human health, material attributes, sustainability

Picking one material over the other too simplistic given variation of factors in each situation (i.e. will package end up in place where it can compost? How will it be shipped? What collection technique?)

Key Metrics in Play

- In the US:

  Walmart and **SPC- Compass** are the main metrics used

  SPC is gaining major foothold across the industry (GMA, FCPC, PAC)

- EU and Global Efforts:

  Consumer Goods Forum/ Global CEO Project creating global metrics- i.e. the **Global Packaging Project**

Issues to Consider in Evaluating LCA Tools

- Was the analysis Cradle to… Gate /Grave/Cradle?
- Are additives, inks, coatings considered or only base materials?
- Influence of the package on its contents? (is this your concern?)

Some Common Sustainable Packaging System Approaches

- Drastic shift from materials focus to packaging/product system focus
- They say there is multi-stakeholder input- but public and NGOs sorely missing
- Significant investment in development, especially where using life cycle databases
- Inclusion of key performance parameters- but these differ from one to the next

Mostly it boils down to LCAs

- All the metrics and scorecards rely on Life Cycle Analysis
- These are only as good as the data input
- Incredibly variable results depending on data inputs

Glass vs. Plastic Baby Food Jar

LCA for Nestle baby food jar to be sold in France, Spain and Germany:

- Package production, product assembly, distribution, and EOL
- Concludes plastic jar slightly preferable to glass

BUT many assumptions which can lead to large variations if incorrect:

- Energy used: (used natural gas- based on EU grid)
- Transportation: (used generic data from Ecoinvent- but in each country load requirements and logistics are different- the type of transport may differ, etc.)
- Distribution distance: depends on start and end point
- Used packaging collection rate
- Efficiency of incinerators variable
- Recyclability of multilayer polypropylene cup (assumed 40%)

LCA and Green Design in Polymers

Found biopolymers rank high in green design, but large environmental impacts in production (Tabone, Cregg, Beckman, Landis, Environ Sci and Technology Sept 2010)- Mascaro Center for Sustainable Production, University of Pittsburg

- Compares PET, HDPE, LDPE, PP, PC, PVC, PS (all petroleum-based) with polylactic acid (PLA-G and PLA-NW), and polyhydroxyalkanoate (from corn/PHA-G and from stover/PHA-S), and dual petroleum and corn based B-PET
- Used two LCA methods approved in accordance with ISO14040-14043-
  - Ecoinvent v1.2
  - EPA Tool for Reduction and Assessment of Chemical and Other Impacts (TRACI)
- Cradle to Gate assessment- i.e. assessed production impacts

2 approaches to Green Design: Green Chemistry vs. LCA/ Engineering

12 Principles of Green Chemistry

GC 1. Prevention (Overall)
GC 2. Atom Economy
GC 3. Less Hazardous Chemical Synthesis
GC 4. Designing Safer Chemicals
GC 5. Safer Solvents and Auxiliaries
GC 6. Design for Energy Efficiency
GC 7. Use of Renewable Feedstocks
GC 8. Reduce Derivatives
GC 9. Catalysis
GC 10. Design for Degradation
GC 11. Real Time Analysis of Pollution Prevention
GC 12. Inherently Safer Chemistry for Accident Prevention

12 Principles of Green Engineerin

GE 1. Inherent rather than circumstantia
GE 2. Prevention instead of treatment
GE 3. Design for separation
GE 4. Maximize mass, energy, space, an
GE 5. Output-pulled versus input-pushe
GE 6. Conserve complexity
GE 7. Durability rather than immortality
GE 8. Meet need, minimize excess
GE 9. Minimize material diversity
GE 10. Integrate local material and energ
GE 11. Design for commercial "afterlife"
GE 12. Renewable rather than depleting

LCA Assessments using TRACI impact categories

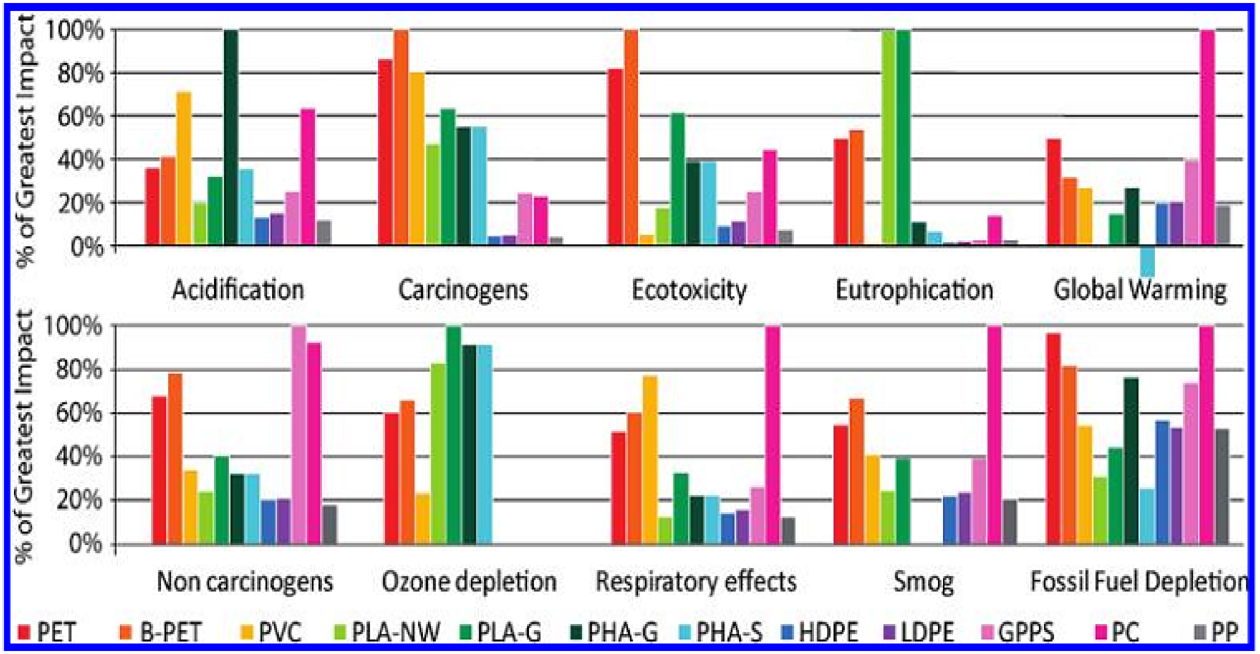


FIGURE 2. Life cycle assessment results for each of the polymers in TRACI impact categories. The top chart displays each polymer's relative impact in acidification, carcinogenic health hazards, exotoxicity, eutrophication, and global warming potential. The bottom chart displays each polymer's relative impact in the noncarcinogenic health hazards, ozone depletion, respiratory effects, photochemical smog, and fossil fuel depletion categories. All impacts are normalized from their original units to their relative impact as compared to the greatest impact exhibited in this study.

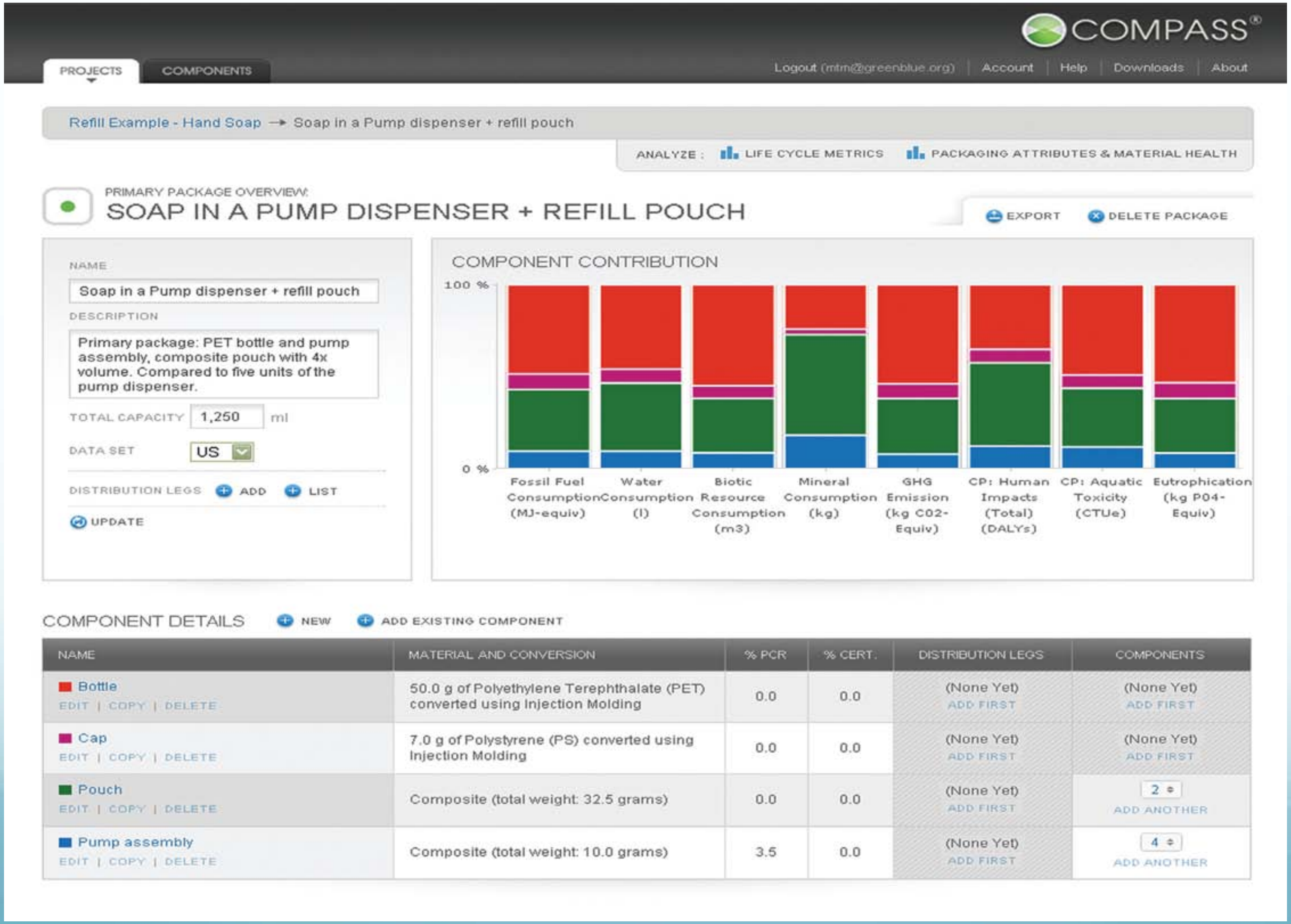
Rankings of each Polymer Using Green Design and LCA impact analysis

TABLE 3. Rankings for Each of the Polymers Based the Normalized Green Design Assessment Results and the Normalized Life Cycle Assessment Results

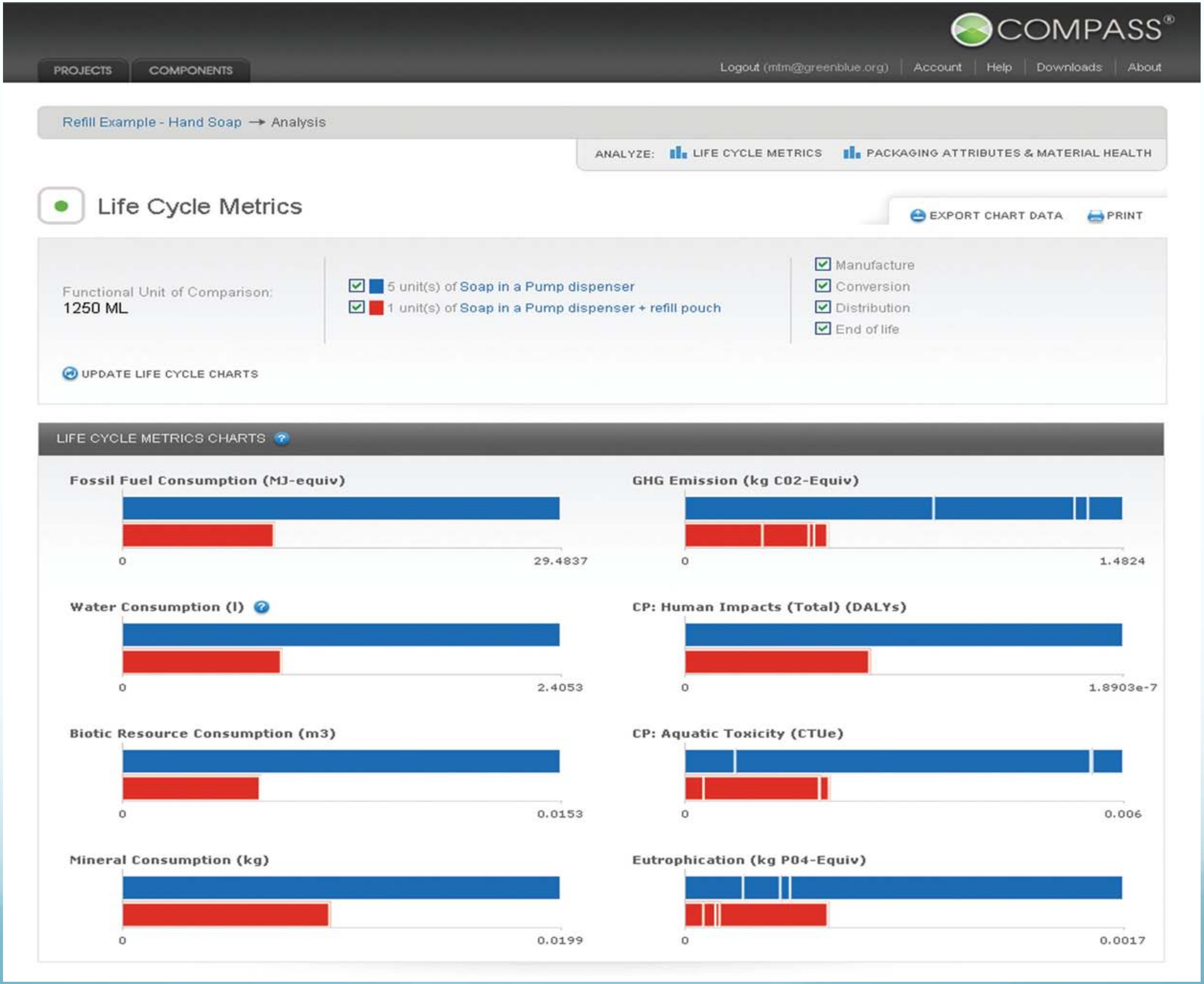
Material	Green Design Rank	LCA Rank
PLA (NatureWorks)	1	6
PHA (Utilizing Stover)	2	4
PHA (General)	2	8
PLA (General)	4	9
High Density Polyethylene	5	2
Polyethylene Terephthalate	6	10
Low Density Polyethylene	7	3
Bio-polyethylene Terephthalate	8	12
Polypropylene	9	1
General Purpose Polystyrene	10	5
Polyvinyl chloride	11	7
Polycarbonate	12	11

SPC - Compass

A metrics tool that allows user to compare 4 packaging system scenarios (primary package, plus secondary and transport)



a) Sustainable Packaging Coalition – Design Guidelines (2006)	
Type of approach (scorecard, design guidelines, regulation, life cycle decision-making tool, etc.)	▪ Design Guidelines
Intended user	▪ Primary audience – Product/ Packaging Designers
Mandatory or voluntary	▪ Voluntary – intended to provide best practice
Definition of sustainable packaging	*Sustainable packaging is*[4]: ▪ Is beneficial, safe & healthy for individuals and communities throughout its life cycle; ▪ Meets market criteria for performance and cost; ▪ Is sourced, manufactured, transported, and recycled using renewable energy; ▪ Maximizes the use of renewable or recycled source materials; ▪ Is manufactured using clean production technologies and best practices; ▪ Is made from materials healthy in all probable end of life scenarios; ▪ Is physically designed to optimize materials and energy; ▪ Is effectively recovered and utilized in biological and/or industrial cradle to cradle cycles.
Scope of packaging system covered (life cycle stages addressed)	▪ Full life cycle perspective
Performance parameters measured	▪ Source reduction ▪ Recycled content ▪ Design for transportation ▪ Design with environmental best practice ▪ Design with fair labour and trade practices ▪ Design with renewable virgin materials ▪ Sustainably managed sources ▪ Green chemistry and green engineering ▪ Design for reuse ▪ Design for recycling ▪ Design for composting


COMPASS®
PROJECTS
COMPONENTS
Logout (mtm@greenblue.org)
Account
Help
Downloads
About
Refill Example - Hand Soap → Analysis
ANALYZE: LIFE CYCLE METRICS
PACKAGING ATTRIBUTES & MATERIAL HEALTH
Life Cycle Metrics
EXPORT CHART DATA
PRINT
Functional Unit of Comparison:
1250 ML
5 unit(s) of Soap in a Pump dispenser
1 unit(s) of Soap in a Pump dispenser + refill pouch
Manufacture
Conversion
Distribution
End of life
UPDATE LIFE CYCLE CHARTS
LIFE CYCLE METRICS CHARTS
Fossil Fuel Consumption (MJ-equiv)
0
29.4837
GHG Emission (kg CO2-Equiv)
0
1.4824
Water Consumption (l)
0
2.4053
CP: Human Impacts (Total) (DALYs)
0
1.8903e-7
Biotic Resource Consumption (m3)
0
0.0153
CP: Aquatic Toxicity (CTUe)
0
0.006
Mineral Consumption (kg)
0
0.0199
Eutrophication (kg PO4-Equiv)
0
0.0017

SPC Approach

- Not entirely based on LCA approach
- Incorporates a number of environmental, social, and economic metrics for which there are not yet any LCA standards or protocols
- Audience: brand owners and retailers
- Not a standard for public reporting and its use is voluntary

Compass

Compass is the software application developed from SPC's Packaging Indicators and Metrics Framework

a design-phase tool that provides comparative environmental profiles for packaging designs based on life cycle assessment metrics and packaging attributes

SPC approach- very subjective

Before using the indicators and metrics, user is advised:

- Set boundary and scope for measurement project
- Determine whether measuring gate-to-gate, cradle-to-cradle, cradle-to-gate, cradle to grave
- Determine use of industry average life cycle data or organization’s performance data
- Select indicators and metrics relevant to your business goals, position in supply chain, and downstream supply chain partners’ expectations.

Global Packaging Project

Based on Europen and SPC

Will be the European standard

Likely a more global standard

Performance categories

- Material use
- Energy Use
- Water Use
- Material Health
- Clean Production and Transport
- Cost and performance
- Community impact
- Worker Impact

Walmart Packaging Scorecard

- Greenhouse Gas Emissions
- Sustainable Material
- Average Distance to Transport Materials
- Package to Product Ratio
- Cube Utilization
- Recycled Content
- Recovery Value

Sustainable Plastics:
Biz NGO Working Group

- **<u>Resources</u>: Extract or Grow Resources in a Sustainable Manner and Use Resources Efficiently**– Minimize the environmental impacts of growing, harvesting or extracting natural resources used as feedstocks for plastics. Design or select materials to minimize material use and maximize material reuse. Keep materials in use as long as possible through reuse, repair, remanufacturing, recycling and composting.

- **<u>Energy</u>: Utilize Renewable Energy and Use Energy Efficiently -** Use or purchase renewable energy sources derived from natural processes. This includes electricity and heat generated from solar, wind, ocean, hydropower, biomass, geothermal, biofuels and hydrogen-derived from renewable resources. Minimize the energy and carbon intensity of materials through efficient design of material processing systems.

- **<u>Chemicals</u>: Use Safer Chemicals throughout the Life Cycle –** Select inherently safer feedstocks, chemicals, processes and reaction pathways for each life cycle stage, including: agricultural chemicals, fossil resource extraction chemicals, primary chemicals, intermediates, monomers, polymers, additives, catalysts, solvents and processing aids. Ensure that these selections result in byproducts, waste streams, degradation products and transformation products that are inherently safer.

- **<u>Social benefits</u>: Maximize Social Benefits –** Design and select materials that are produced in a socially responsible manner, including fair wages, safe working conditions, no child labor, positive impact on local communities, environmental justice, no discrimination, no forced or compulsory labor, freedom of association and/or collective bargaining. Provide consumers with product information such as chemical content and hazards. Ensure that marketing claims are credible and verifiable.

- These principles have been informed by and incorporate concepts from the 12 Principles of Green Chemistry, the Organization of Economic Cooperation and Development Sustainable Materials Management Principles, Cradle-to-Cradle design principles, Principles for Sustainable Biomaterials (developed by the Sustainable Biomaterials Collaborative, and the Global Reporting Initiative.

Biz-NGO working group- Sustainable Biomaterials Collaborative standards

BioMass Production:

•No GM, no plastics made directly in plants, sustainably grown

Manufacturing:

- No chlorine, no additives that are chemicals of high concern, all chemicals must be tested

End of Life:

- Compostable, labeled for compost, biodegradable in marine environment

THIS IS NOT THE INDUSTRY STANDARD!

Are you confused?

HUH? Just tell me which package is better!

Bio-Plastics

Need further evaluation of:

- Impact on recycling
- Toxicity- Chico State report shows none, but test used was “plant emergence survival and growth”
- Trade secrets has precluded even DTSC from discovering the additives

Industry Perspective

- According to USDA research (38) processed (packaged) fruit and vegetables suffer only half the waste of that suffered by fresh fruit and vegetables in the retail chain and home environment combined (16% versus 32%).

- An unwrapped cucumber loses moisture and becomes dull and unsaleable within 3 days. Just 1.5 grams of wrapping keeps it fresh for 14 days. Selling grapes in trays or bags has reduced in-store waste of grapes by 20%. In-store wastage of new potatoes reduced from 3% when sold loose to less than 1% after specially designed bags were introduced (39).

EUROPEN (2009) “Packaging in the sustainability agenda: a guide for corporate decision-makers”

Prevention and Re-use- Makes More Sense

- A ceramic mug used 1,000 times requires 3 pounds of material inputs and creates 4.7 pounds of solid waste,
- while an equivalent 1,000 polystyrene disposable cups each used once requires 12 pounds of material inputs and creates 8.7 pounds of solid waste (not including the additional packaging or upstream solid waste associated with the disposable cups).
- A steel spoon used 1,000 times requires 0.3 pounds of material inputs and creates 0.3 pounds of solid waste
- while 1,000 polypropylene spoons each used once require 4.7 pounds of material inputs and create 4.6 pounds of solid waste (not including packaging or upstream solid waste associated with the disposable spoons).